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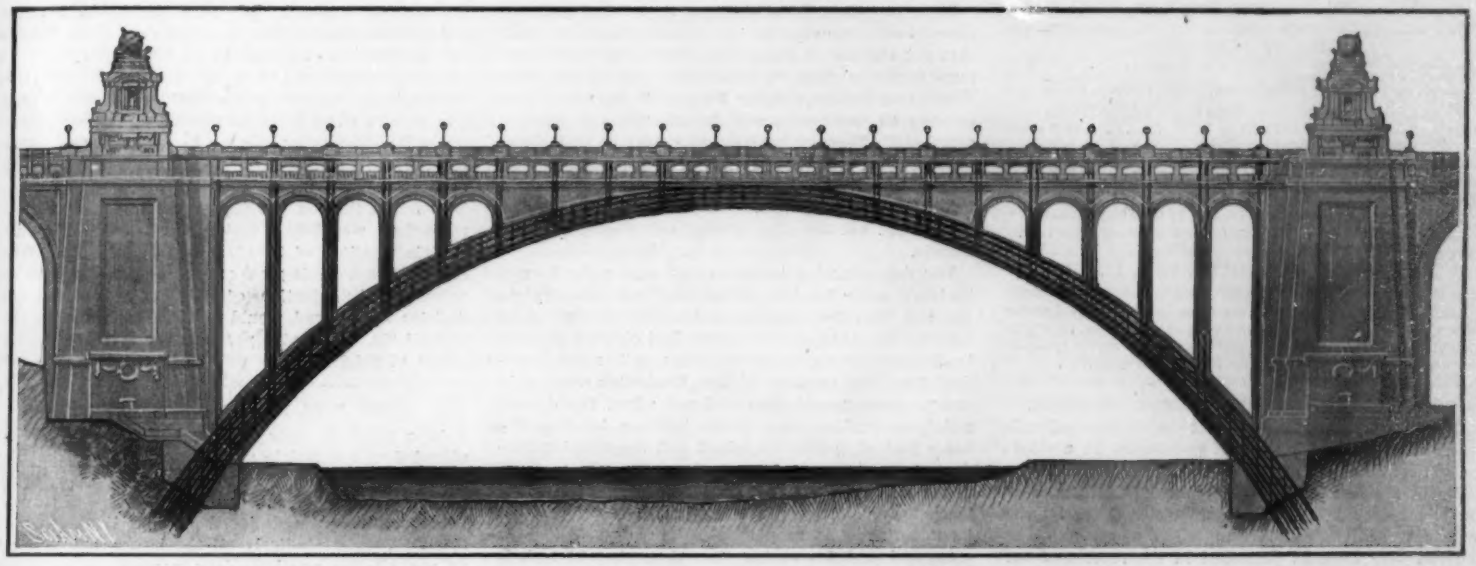
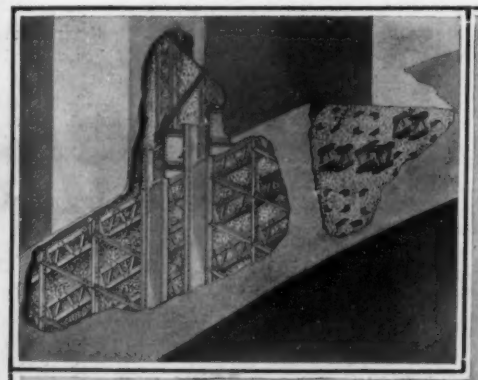
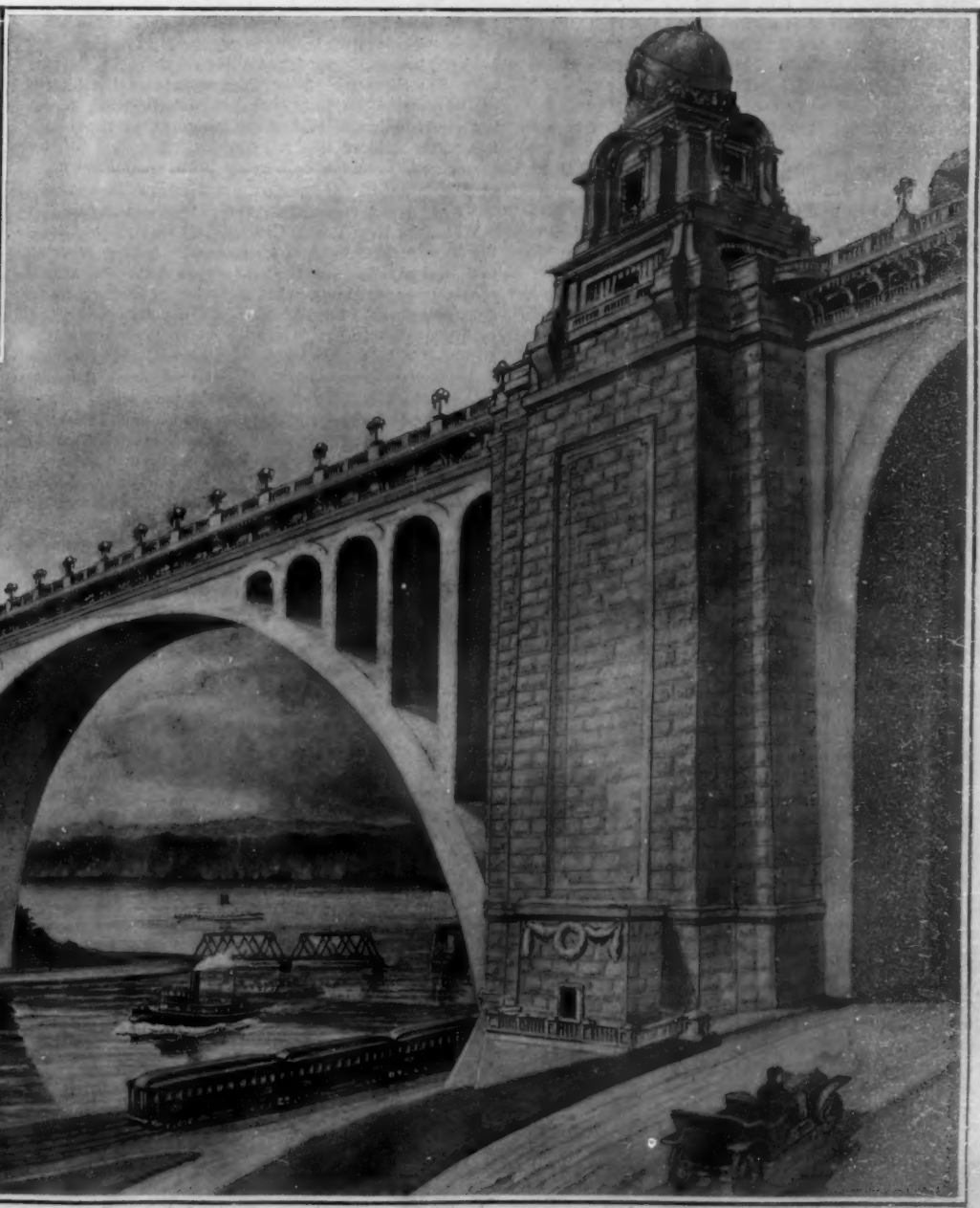


Side Elevation of Bridge, Showing, in Black, the Steel Re-enforcement. This Steelwork Constitutes a Complete Trussed Arch in Itself.



Sectional view at junction of column and rib, showing the thorough character of the steel re-enforcement.



Span, 703 feet. **Width,** 70 feet. **Rise of Arch,** 177 feet. **Total length,** 2,840 feet. **Materials of construction:** Steel and concrete. This arch will be over two and a quarter times as long as the next longest concrete or masonry arch in existence.

THE GREAT ARCH OF THE HENRY HUDSON MEMORIAL BRIDGE, NEW YORK.—[See page 258.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, APRIL 11, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

BRITISH AND AMERICAN RAILWAY ACCIDENTS.

It is not generally known that the British railroads carry a far larger number of passengers in a single year than do those of the United States; and this in spite of the fact that the aggregate mileage in Great Britain is about 27,000 as against over 200,000 miles in the United States. A comparison of the statistics for the year 1906, as published in the reports of our Interstate Commerce Commission and of the British Board of Trade, show that during the year 1906, 799,000,000 passengers were carried on all the railroads of the United States and 1,240,000,000 passengers on the railroads of Great Britain. Now, the carrying of a billion and a quarter passengers on 27,000 miles of road means a very much denser traffic than the carrying of 800,000,000 passengers on over 200,000 miles of railroad. Furthermore, it will be admitted that the risks of accident are proportional to the density of the traffic, and that, on two equally well-managed railroad systems, we naturally expect to find that the greater number of accidents happen on the road with the denser traffic, or the one carrying the larger number of passengers per mile of track.

A comparison of the statistics for 1906, however, shows that as far as the United States and Great Britain are concerned, the system with the denser traffic shows by far the smaller number of casualties. It is probably safe to say that the surest test of safe railway operation is the number of collisions and derailments; and we find that during the year named there were 239 such accidents in Great Britain as against 13,455 in the United States. In these accidents 58 passengers were killed and 631 injured in Great Britain, as against 146 killed and 6,053 injured in the United States. The number of employees killed and injured in Great Britain in train accidents was respectively 13 and 140, as against 879 killed and 7,483 injured in the United States. The number of employees killed by coupling accidents, falling from cars, etc., in Great Britain was 425, and in the United States 2,338, and the number of employees injured in the year was 4,225 in Great Britain as against 32,564 in the United States. The astonishing disparity between the records of the two countries is further established by the records for the year 1904, when only six passengers were killed and 534 injured in Great Britain as against 262 killed and 8,231 injured in this country.

Although the superior safety of British railroad operation is due in large measure, no doubt, to the higher average of excellence of the roadbed and rolling stock—a considerable portion of our railroad system being even yet of the pioneer type—the true secret of the difference is to be found in certain fundamental traits of national character. The smooth and safe working of the British railroad is chiefly due to the inbred cautiousness of the employees; to their natural inclination to remain for many years in the same position, thereby acquiring thorough familiarity with the conditions; and, lastly, and chiefly, to the excellence of the railroad discipline. There can be no doubt that the prevalence of railway accidents in America is due in large measure to the fluctuating, migratory character of the labor. A census of railway employees at any given time would show that a considerable percentage of them are either new to their positions, or are contemplating a change in the near future. No amount of natural intelligence and alertness can give the American railroad man that familiarity with the duties of his position which marks the British employee, who has probably held his job for a dozen or fifteen years past.

Even more serious, as a predisposing cause of railway accidents, is the lamentable lack of discipline which is becoming increasingly manifest in these days of labor union interference. This has been carried to such a point, that the officials of our railroads have no longer that direct control of the employees which is absolutely essential to the maintenance of discipline. Until this condition of things has been changed, it is hopeless to look for any material reduction in the annual number of killed and wounded on our railroads.

EAST RIVER BRIDGE NUMBER FIVE.

With two East River bridges in service, and two others under construction, the announcement is made that yet another of these huge structures, larger and more important than its predecessors, to be known as East River Bridge Number Five, is to be commenced as soon as the preliminary borings for the site are completed. The new bridge, which will be of the suspension type, will have a main span longer than that of any bridge in existence, and its floor system will have a greater capacity. It will be erected to the east of the old Brooklyn Bridge and closely adjacent thereto.

The determination to proceed at once with the preliminary work for this bridge was due somewhat to the fact that the opening of the East River tunnel between Brooklyn and Manhattan had diverted so little traffic from the old Brooklyn Bridge, as to make it evident that the opening of the Manhattan Bridge in two or three years' time will not afford the desired relief—so rapidly does traffic increase between the lower part of Manhattan Island and the outlying residential districts. It is true that a certain measure of relief will be afforded by the reconstruction of the floor system of the old Brooklyn Bridge, which will be undertaken as soon as the Manhattan Bridge is open, and probably earlier than that. It will include the entire rebuilding of the floor, during which the latter will be widened, and deeper and stiffer trusses provided. Auxiliary cables will also be strung, upon which will devolve the duty of carrying the added load. The contracts for making borings to determine the character of the foundations for the piers of the new bridge have been let, and the work thus far done indicates that a satisfactory material exists at the desired site.

GREAT ECONOMY OF ELECTRIC TRACTION ON STEAM RAILROADS.

When the New Haven Company decided to electrify the New York division of its system from New Haven to Woodlawn, it became necessary to determine with considerable accuracy what capacity of boilers and generators would be necessary at the power house to maintain electrically the service which is now run by steam. To this end, ten steam locomotives were selected that were engaged in hauling express and local trains, and for a period of eighteen consecutive days the power developed was determined by carefully-taken indicator cards. From the data thus secured, it was possible to ascertain the pounds of coal consumed per ton-mile, and the horse-power-hours per ton-mile. Also, the total work to be done in hauling all the passenger trains on this division was ascertained with great accuracy; and since the losses in the motors, the transmission line, and the generating plant were well known, it was a simple matter to figure back to the power house and determine the amount of kilowatt capacity that would be required to operate a predetermined schedule of trains. It was assumed that the machine efficiency of the steam locomotive was about equal to the machine efficiency of the electric motor. The broad difference in economy between the two systems, steam and electric, lies, of course, in the superior efficiency of the water-tube boilers of the power house over the fire-tube boilers of the locomotive.

The estimated saving in fuel, due to power house boiler efficiency, when the whole of the New York division is in operation, was given by Mr. W. S. Murray at a recent meeting of the American Institute of Electrical Engineers. The figures represent the saving of fuel on the New York division when all freight and passenger trains, now operated by steam, are drawn by electric motors. To haul the express, local, and freight trains of this division by steam locomotives, involves the consumption respectively of 57,000, 58,000, and 188,000 tons of coal. When the whole division is operated electrically, the amount of coal burned at the power station for the respective classes of service will be 30,000, 28,000, and 139,000 tons of coal; and the saving in cost of fuel consumed by the electric over the steam traction will amount in one year to $341,470. In express service by steam locomotives, 2,055 indicated horse-power-hours are developed in the evaporation of 57,594 pounds of water, which gives an average of 28 pounds of water per indicated horse-power-hour. On local trains the evaporation works out at 30 pounds of water per indicated horse-power-hour. The builders of turbine generators are always ready to guarantee the evaporation of 20 pounds of water per kilowatt hour, which is the equivalent of 15 pounds of water per indicated horse-power-hour. From these figures Mr. Murray deduces that by the electric method of traction twice the draw-bar pull can be developed for coal burned under the boilers of stationary plants, as compared with coal burned in the fireboxes of locomotives.

In the same discussion the figures of cost and repairs of twenty steam freight and passenger locomotives on the New Haven road were given, which show an expense of 8.1 cents per locomotive mile for freight engines, and 5.6 cents for passenger engines. The engine mileage of the New York division of the New Haven road amounts, per year, to 4,836,992 miles; and on these figures the operating cost of the locomotive service is established at $316,962 per annum for the maintenance and repairs. Compared with this, the available figures on the cost of electric locomotive repairs show it to be about 2 cents per locomotive-mile. Increasing this by 25 per cent, and assuming that an equal number of electric locomotives will do the same work as the present steam locomotives, it is found that on the item of maintenance and repairs there would be a saving, due to the adoption of electric traction, of $196,038 per annum. Hence the combined net saving on coal and on locomotive repairs, by the adoption of electric traction on this division of the road, would amount annually to a sum of $562,470, which at 5 per cent represents a capitalization of $11,249,000.

OIL FUEL IN THE BRITISH NAVY.

As a result of their experiments, which have been attended with complete success, the British Admiralty have decided to utilize liquid fuel upon an extensive scale in the future. All the new ocean type of torpedo-boat destroyers are designed to burn liquid fuel exclusively, while similarly all the larger warships are to use oil for supplementary purposes more extensively than they have hitherto done. In order to insure an adequate supply of oil independently of the ordinary sources and the fluctuations in the market price of the commodity, the government has secured the extensive oil fields of Nigeria, so that ample supplies of oil will be available in times of peace and war. For the storage of the liquid at the dockyard at Portsmouth huge tanks are to be erected, capable of storing 20,000 tons. The tanks will be surrounded on all sides by earthworks for protective purposes, and will moreover be built in independent sections. From these tanks supply pipes are to be laid down to the jetties alongside which the warships lie during refitting, and thus the fuel will be pumped direct from the tanks into the vessels' double bottoms and bunkers. The naval authorities as a result of their investigations have evolved a special type of apparatus for spraying and atomizing the fuel, and have overcome the difficulties of imperfect combustion and smoke, which at first attended the experiments. The advantages resulting from the use of liquid fuel are reduced personnel in the stokehold, the improved facilities available for carrying the fuel in bulk as ballast in the double bottom, where as it is consumed it can be replaced by water, the solution of the difficulty of coaling at sea, the lesser space required for carrying fuel, and the facility with which it can be handled, combined with the ease with which stoking can be carried out, even when traveling at full speed, without exposing the men to fatigue under the most arduous conditions; and lastly the great heat that can be obtained. Some idea of the developments that are in progress in this direction may be gathered from the fact that the "Dreadnought" has accommodation for carrying 500 tons of oil, while the vessels of the "King Edward" class have their furnaces adapted throughout for burning liquid fuel, and all the largest battleships and cruisers are provided with facilities for carrying it for supplementary purposes. Their oil fuel capacity is to be enlarged as they are successively returned to the dockyard for overhauling.

In order to determine the effect of diet in tuberculosis, Lannelongue and Achard commenced by submitting sixty male guinea pigs of approximately equal weights to the same regimen. Then all the animals were inoculated, in the pleura, with equal doses of the same culture of the bacilli of tuberculosis. The guinea pigs were then divided into three groups, of twenty each, and to each group was given a special food in addition to the common diet. Each animal of the first group received daily 9 grammes of butter, each of the second group 20 grammes of sugar, and each of the third group 20 grammes of gluten. Each of these increments had a food value of about 145 calories. The last survivor of the butter group lived 40 days, the last of the sugar group 87 days, and the last of the gluten group 371 days, or more than a year. These results of experiment corroborate the earlier researches of Lannelongue and Achard, and prove that nitrogenous substances should enter largely into the diet of consumptives.

A PRODUCER-GAS-DRIVEN AUTOMOBILE.

Various efforts have been made with a view to adapting producer gas to the internal-combustion gas engine as represented by the ordinary gasoline motor, but the inherent difficulties have been of such a character as to render the mechanisms evolved for this purpose commercially impracticable. The late Herr Capitaine evolved a special type of suction gas engine, but its utilization has been confined to boats, no attempt having been made to apply it to road vehicles. Recently, however, an interesting vehicle, in which the motor of the ordinary four-cylinder gasoline type derives its fuel from a small producer, has been invented by the Automobile Gas Producer Syndicate of Glasgow, and has been subjected to a series of trials in Scotland, the results of which have been highly gratifying. The vehicle in general appearance resembles the motor *char-a-banc*, which is so popular a public service vehicle in Great Britain, especially in the seacoast towns.

The engine develops 40 brake horse-power when running on gasoline, and but 30 brake horse-power when using producer gas. It is placed in the usual front position beneath the bonnet. The compression is approximately 115 pounds per square inch, which experiment has proved to be the most suitable with this new type of fuel. Both low-tension magneto and high-tension ignition with accumulators and coil are fitted, since both are found to answer equally well in firing the charges, the latter being used for starting and as a reserve. The normal speed is 900 revolutions per minute, the power being transmitted through the usual three-speed change gear and side chains.

The gas producer is placed immediately behind the engine, between the latter and the dashboard. It has been found possible to reduce its dimensions to a small compass. It extends the full width of the chassis, and is about 18 inches deep, while it extends from just below the top level of the dashboard to within about 12 inches of the ground. The grate area is about 12 square inches, and the fuel rests on a specially designed grid, upon which the water is sprayed in the center through a four-spray nozzle.

On a level with the fuel grid is a small airtight door secured in position by means of a crossbar and clamping screw, by means of which the fire is lighted and the clinker and ash removed. The upper part of the producer, which forms practically an integral part thereof, is occupied by the fuel hopper. This is charged through small openings in the top rendered airtight by means of special cone joints, it only being necessary to open these once a day—in the morning before starting out—since a single charge is sufficient for a full day's work. The air blast is forced into the bottom of the producer by means of a powerful rotary blower driven by chain from the engine shaft, while it is also fitted with a hand-operating device for the purpose of setting the fire going after lighting. In order to control the generation of the gas, as well as to reduce the temperature and dispense with the steam jet that is generally utilized in such plants for this purpose, variation in the quantity of fine pulverized water fed through the nozzle mentioned above is effected by a special pump. This is accomplished by an ingenious arrangement. There is a novel rotary plunger pump fitted and driven from the engine by a lay shaft, by which the water is forced from the tank into the center of the fire. This pump works automatically and has the most delicate adjustment, so that the temperature of the fire and the extent of the gasification is carried out according to the requirements of the engine independently of the driver, the pump practically fulfilling the function of a governor. It has been in the regulation of the air and water supplies that the greatest difficulties have been encountered, since in some of the early experiments, it was found that the speed of the water pump and air blast were too high, and that gas adequate for a 50-horse-power engine was being produced, whereas the engine only developed 25 horse-power. Consequently, about half the gas that was produced was unused and escaped as waste into the atmosphere.

From the producer bottom the gas escapes into a pipe conveying it downward through the hopper to a coke scrubber suspended beneath the frame of the vehicle; thence it passes through a second pipe into the mixing chamber, where it is mixed with the right proportion of air for combustion, the entry of the air being controlled through adjustable cocks, one of which is carried to the dashboard, so that the driver can supplement or decrease the air supply for this purpose. Thence the mixture passes to the throttle valve, controlled from the steering column, from which it is induced into the combustion heads of the engine cylinders through the inlet valves.

The engine control is very simple. On the steering column are three levers, the first operating the ignition, the second the injection of water into the producer, and the third the throttle valve; while the production of the gas, as already explained, is controlled automatically, so that the same degree of richness of the gas is secured at all speeds and under all and varying conditions.

During the past year the system has been subjected to several severe and exacting tests to determine its suitability to heavy traction duties, and for the purpose of improving and removing various defects as they developed, which have been duly accomplished, so that now its commercial practicabilities are established. Recently a series of further experiments were carried out to ascertain the running costs and the economies possible to producer gas operation as compared with gasoline. In these latter experiments, although coke was originally selected as the fuel to be employed, anthracite pearls were subsequently preferred. The hopper has a capacity for some 640 pounds of fuel, while the fire is started with three pounds of charcoal. Within five minutes of lighting the fire, the car can be set in motion, and from that time no further attention to the producer is necessary. The distance covered upon the latest of these tests was 40 miles, at an average speed of from 10 to 11 miles per hour. For the run 145 pounds of fuel were used, the vehicle weighing with its passengers 4.9 tons. This represents a fuel consumption of approximately 0.74 pound of anthracite per ton mile. The coal cost $3.54 per ton, so that the fuel running costs represented about 0.12 cent per ton mile, or about 24 cents for the 40-mile journey. The same vehicle working under precisely similar conditions with gasoline fuel cost about 1.34 cents per ton mile, the spirit at the time costing 28 cents per gallon. Under these circumstances it will be realized that running expenses with producer gas are considerably lower than with gasoline, in this instance a saving of 1.22 cents per ton-mile being effected. It must be pointed out, moreover, that the working conditions were not the most favorable to economical efficiency, since no modification was made in the movement or diameter of the inlet valves, which were of the type usually adopted in general motor practice. More satisfactory and economical consumption results would be available were the valves mechanically operated, and with about twice the inlet area to the explosion chamber. At the same time the results have been sufficiently conclusive to prove the suitability of the system to all-round automobile work, and various vehicles of this type are now in course of construction.

LIME BETON

BY J. W. MOULTRIE.

Someone has said that the average American is a slave to fashion. While this, of course, is not true, there is a tendency in some quarters to overlook some mighty good things that other countries use with great success. A case in point is concrete. One hardly ever, nowadays, sees anything going into a batch of concrete, no matter for what use it is to be put, but Portland cement, broken stone or gravel, or both, and sand. We seem to have overlooked entirely the fact that, for some purposes, broken brick is an excellent substitute for broken stone or gravel, and good, well-burned lime for cement.

The writer was recently connected with the construction of foundations for a large monumental building, which was erected on a site previously occupied by a large power house. In taking out the old foundations, the drawings and specifications for which had been destroyed by the fire that burned the power station, it was found that most of the footings and bearing walls up to the superstructure, were of brick concrete. It proved to be a beautiful piece of work, and it seemed a pity to destroy it. This had to be done, however, but the task was by no means an easy one, the mass having become almost as hard as granite.

Lime concrete, or lime béton as the French call it, has been in longer and more general use than cement concretes. It was a first-class material when made with ordinary quicklime, and since hydraulic lime has been used it is better. It is a much cheaper composition than cement concrete, easier to work, and if the initial load be not too great, it is for many uses just as good. A good lime béton can be obtained by mixing mortar, stones, and gravel, or cinders, mortar, and good-sized stones, which makes the best composition. Such a composition is very popular in France. Probably one-half of the houses in Marseilles have been built of this material, and thousands of the older buildings, many hundreds of years old, are held together with ordinary lime. Walls built of quicklime béton must be laid up very slowly, but with hydraulic lime béton they can be erected as fast as the masons can work. The solidity of lime béton construction is shown by the sea walls and docks in Marseilles, where masonry of this kind can be seen both below and above sea water, the most difficult test to which a building material can be subjected.

The lime is weighed out to the cubic unit of sand, and the two dry-mixed until thoroughly incorporated. Water is added slowly with a sprinkler, and the plastic consistency tested by forming a ball with the hands, which should exude a slight moisture, and being laid aside should neither flatten nor crack open. Stones or other cheap material are mixed with the mortar, thus constituting the béton. Cinders, coke, and furnace slag are often substituted for stones in ordinary house and wall work. If broken stone is used, it is broken to from ¾ inch to 2½ inches across. The proportions are usually two parts of stone to one part mortar for work under water; in air and above ground the proportion of stone may be increased.

The form, of course, is the same as for cement concrete, and the béton is usually placed in eight to twelve-inch layers and rammed. The surface is scratched and treated with a wash of thin mortar or grout before putting on the next layer.

In both France and Germany a light-weight béton is made of cinders. Buildings several stories high of this material are common, but when they exceed one story in height, they are reinforced with the usual steel rods. Several very large factory buildings have been built at Lyons of this béton.

Striking economies are effected in France by the free use of cheap local material, whatever it might be, and by the equally free use of lime where cement would probably be used in the United States.

THE LATEST INTERNATIONAL AERONAUTIC PRIZE.

On another page will be found a list of aeronautical prizes offered abroad for flights by aeroplanes or other heavier-than-air flying machines. Included in this list is the $2,000 trophy and $50,000 in cash prizes offered recently by M. Michelin. Of the latter sum, $30,000 is to be given annually in ten $3,000 installments to the winner of the trophy each year, while the remaining $20,000 will go to the aviator who, within the next decade, makes a flight and carries one passenger from Paris, France, to the top of the Puy de Dome—a mountain 4,775 feet high, some 220 miles distant. In the course of its flight, the machine must circle around the Arc de Triomphe in Paris, and also around the cathedral at Clermont-Ferrand. The flight must be accomplished within six hours, which means that the aeroplane must have a speed capacity of nearly 40 miles an hour.

In donating the trophy and series of cash prizes, M. Michelin has provided for an annual international competition for these in any countries where there is an aero club belonging to the international federation. The rules governing the flight for this year will soon be issued by the Aero Club of France. They will provide for a flight of at least 2 kilometers (1¼ miles) in a closed circuit having several turns. If a flight of the distance set is accomplished, the aviator who makes such flight will be declared the winner, unless some other aviator makes a longer flight under the same conditions before the end of the year. In this event, the cup and cash go to the aviator who covers the longest distance. The flight required in any one year is to be twice as long as that accomplished in the preceding year. Should the cash prize not be won during any year, it will be added to that given the following year. The winner of the trophy the tenth year will be declared the owner of the same, and a duplicate trophy will be given to the aero club which he represents.

The provisions in the deed of gift of this new aeronautic trophy, and its accompanying cash prizes, make both immediately available to be competed for in this country under the supervision of the Aero Club of America; and the officers of the club have already taken steps to secure a suitable course over which to hold this contest, as well as that for the SCIENTIFIC AMERICAN trophy, which, although offered over a year ago for a simple straight-line flight of one kilometer (3,280 feet), has not as yet been seriously competed for. Should no one lift this cup at the coming contest, the conditions will then be changed and made more difficult, so as to keep them somewhat in advance of the demonstrated state of the art, as was originally intended.

EXTERMINATION OF MOSQUITOES BY CACTUS PASTE.

Consul William Henry Bishop, of Palermo, Italy, transmits the following information relative to experiments made by the chief of the sanitary service at Gaboon, French Africa, with the cactus as a substitute for petroleum for the extermination of mosquitoes in warm climates:

The thick, pulpy leaves of the cactus, cut up in pieces, are thrown into water and macerated until a sticky paste is formed. This paste is spread upon the surface of stagnant water, and forms an isolating layer which prevents the larvæ of the mosquitoes from coming to the top to breathe and destroys them through asphyxiation. It is true that petroleum can do the same service, but in warm climates petroleum evaporates too quickly and is thus of little avail. The mucilaginous cactus paste, on the contrary, can hold its place indefinitely, lasting weeks, months, or even an entire year; and the period of development of the larvæ being but about a fortnight, it has the most thorough effect.

THE FIRST TWO-PASSENGER AEROPLANE.

In view of the requirements of our War Department, whereby it is stipulated that the new aeroplanes which have been contracted for must carry two men, and also of the same requirement in the conditions governing the 220-mile, $20,000 prize flight to be mad within the next decade in France, the photograph which we reproduce herewith will be found interesting, since it shows the manner in which those two noted aeronauts, MM. Farman and Delagrange, were mounted in the latter's aeroplane when, on March 21, they succeeded in making a short flight of 75 or 80 feet. This is the first time, so far as we know, that an aeroplane has flown and carried two people. The flight was made after both the aeronauts had spent the entire morning in making flights with their two quite similar machines. Shortly after 10 A. M., M. Farman made a successful attempt at breaking his best previous record. His flight upon this occasion was conducted similarly to the one he made when he captured the Deutsch-Archdeacon prize on January 13 last, there being two posts located at a distance apart of 500 meters, around which it was necessary to travel. In making the test, the aeroplane left the ground readily after a short run, and flew at an elevation of about 20 feet, making two complete circles and a half circle, and remaining in the air 3 minutes and 29 seconds. Officially, Farman covered 2½ kilometers in this time; but if the speed of his machine is used as a basis for calculating the distance actually traversed, this will be found to be more than 3 kilometers (1.86 miles) or three times the distance covered by him when he won the prize about two months before. Had the water-cooled motor not become overheated, it is probable that Farman could have flown much farther. The machine showed better stability than ever before, and even in making the turns it tipped but little. Late in the afternoon, Farman again took out his aeroplane and described two circles, each about a kilometer in length, in a continuous flight lasting 2 minutes and 45 seconds. He was again obliged to descend on account of the motor overheating. The day before, after refitting his aeroplane with the 8-cylinder, water-cooled, Antoinette motor in place of the similar-type, air-cooled, Renault motor with which he experimented with slight success a week previously, Farman made two flights estimated at 2.3 and 3 kilometers in 2 minutes 50 seconds and 2 minutes and 55 seconds respectively. With the air-cooled motor, Farman only succeeded in flying about 900 feet, though he expects that after his engine has been thoroughly overhauled and tested, he will be able to do even better with it than with the water-cooled engine. On March 27 Farman met with an accident while making a sharp turn. One end of the aeroplane struck the ground, and the aviator was thrown 35 feet. He was badly cut about his face, but not seriously injured.

M. Delagrange's No. 2 aeroplane is practically a duplicate of Farman's machine. On March 21 M. Delagrange succeeded in making several extended flights around the borders of the parade ground. In the longest of these he remained in the air 2 minutes and 5 seconds, and made a complete circle for the first time. On March 17 Delagrange competed for the 200 francs prize for a flight of 200 meters in a straight line. He covered a distance of 269½ meters (884.18 feet) in 21 1-5 seconds, which corresponds to a speed of 28.44 miles an hour. These performances of the sculptor show that the type of machine which he originated, and which was copied and modified by Farman, is capable of being flown by anyone of ordinary intelligence who will sufficiently practise the art. A duplicate of this machine can be had in America for $9,000. A Russian general has ordered one for his government.

MM. DELAGRANGE AND FARMAN ON THE FORMER'S No. 2 AEROPLANE, WHICH IS THE FIRST MACHINE TO RISE IN THE AIR WHEN CARRYING TWO AVIATORS.

List of Aviation Prizes Offered Abroad.

$100 given by A. C. Triaca, of the Correspondence School of Aeronautics, for the longest flight in 1908.

$100 prize of Aero Club of France for the best indicating level.

$200 offered by M. Pepin for the first machine that flies across the Garonne River in France.

$1,000 offered by the Aero Club of France for a flight of 5,000 meters (3 miles).

$2,000 offered by M. Armengaud, Jr., for the first machine that remains in the air 15 minutes.

$2,500 offered by Dr. Gans for a competition at the Munich Exposition this summer for the first machine which remains in the air 10 minutes.

$2,500 offered by Ruinart Fils for the first 18-mile flight across the English Channel.

$2,500 offered by Lord Montague, editor and proprietor of "The Car," to the aeroplane making the longest flight in England in any year. (Also $25 a mile up to 25 miles for said flight.)

$3,000 offered annually for ten years by MM. Michelin for the longest flight in a closed circuit in any country having an aero club in the International Federation. A $2,000 trophy goes with this.

$4,000 in cash prizes for aeroplane races at Vichy, France, next September. Conditions to be announced later.

$5,000 offered by the Daily Graphic for a flight of 1 mile at the Brooklands Automobile Race Track in England.

$12,500 offered by the Brooklands Automobile Racing Association for a 3-mile flight above the Brooklands Race Track.

$14,000 in cash prizes for aeroplane races held July 29 and August 2 and 9 at Spa, Belgium. Ist prize, $10,000; 2d, $2,000; 3d, $100.

$20,000 offered by MM. Michelin for a 220-mile flight from Paris to Puy-de-Dome, France, to be made in six hours (about 36 miles an hour) before January 1, 1919, by an aeroplane carrying two people.

$50,000 prize offered by the London Daily Mail for a flight of 160 miles from London to Manchester. Also $10,000 offered by the Adams Manufacturing Company if the entire machine is constructed in Great Britain, and $2,500 by the Autocar if the motor is of English fabrication.

Exclusive of the last-mentioned special prizes, the cash prizes available for flights are $119,925, while including them the figure reached is $132,425.

A PHYSICIAN'S NOVEL USE OF AN AUTOMOBILE ACETYLENE LIGHT.

It has always been recognized that the automobile was invaluable to the physician as offering a means of covering more ground in less time, but it remained for a doctor in Rome, N. Y., to discover a new use for his little Ford runabout. The doctor in question received a hurry call from fifteen miles out in the country to come prepared to operate for appendicitis. Arriving at 6 P. M., after a half-hour ride, it was found that the condition of the patient was very serious and an operation urgent. In the farm house, as is usual, kerosene oil lamps were the sole source of illumination, the light furnished being quite insufficient for the conducting of a delicate surgical operation. More light was essential, and the manner in which it was obtained is shown in the photograph.

A piece of rubber tubing used for drainage was run from the automobile through the window into the room in which the patient lay. One of the gas lamps was taken off the auto and was pressed into service in the improvised operating room, the supply of gas being drawn from the acetylene generator on the auto, which was backed up beside the house near the window as shown. As soon as the gas was turned on and the lamp lighted, the resulting brilliant illumination permitted the successful carrying out of the operation.

The condition of the patient was such as to demand quick work. Had any other means of conveyance been relied upon, the doctor reports it might have been too late even to operate. It was necessary to operate immediately, and to do so, a clear and powerful source of light was needed. Had the physician's car been furnished with electric headlights fed from the ignition battery, or even had he had as part of his equipment a low-voltage, high-candle-power lamp (tungsten or tantalum) of high efficiency, by removing the battery from the car and taking it in the house, he could have had an excellent odorless source of light which would have compared favorably with that in a well-fitted operating room.

The Acetylene Gas Headlight of the Automobile Furnished Excellent Light for the Performance of the Surgical Operation.

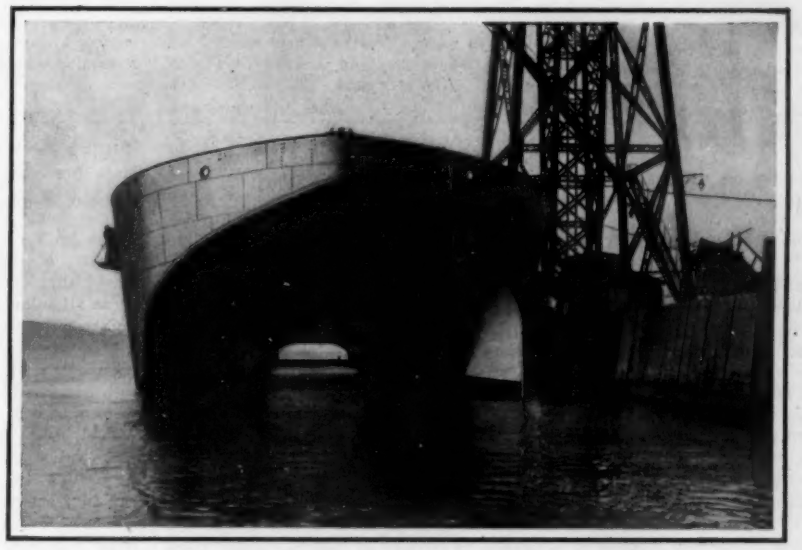
The Gas Generator on the Automobile Was Connected With the Lamp by a Piece of Rubber Drainage Tubing.

A DOCTOR'S NOVEL USE OF THE ACETYLENE LIGHT OUTFIT OF HIS AUTOMOBILE.

A SALVAGE DOCK FOR SUBMARINES.

BY THE BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Owing to the many accidents to submarines that have occurred in the course of the last few years the navy authorities of different countries have turned their attention toward designing a suitable means for raising and docking such boats. In the case of both the French and English submarines that have met with disaster, floats were used for lifting the vessels. The floats were submerged and chains were passed beneath the hull of the wreck. On pumping out the water in the compartments of the floats, the wreck was raised and then hauled into a drydock, after which the submarine was blocked, the floats were removed, and the dock pumped dry before access could be had to the damaged vessel. It will be very evident that this process is a laborious one, especially the task of passing the chains under the hull, and to expedite matters it has been the recent practice to fit the submarine with rings so as to provide means for attaching the chains in case of accident. In order to further simplify the process of docking a wrecked submarine a special salvage dock has recently been constructed for the German navy. A similar dock is nearing completion in France. Both docks are constructed like ordinary drydocks with a central floor flanked by compartments on opposite sides which may be filled or emptied according as the dock is to be submerged or floated. In the case of the "Oberelbe," namely, the German dock just referred to, this central floor is removable, the compartments at each side being rigidly connected to each other by cross beams. The dock is provided with powerful cranes and tackle operated by electricity. In one of the compartments is a generating set which furnishes the required current.



THE "OBERELBE"—A GERMAN SALVAGE DOCK FOR SUBMARINES.
Length, 230 Feet. Capacity, 500 Tons.

When raising a wrecked submarine the floor of the dock is removed and the dock is about two-thirds submerged. The submarine is then lifted by means of the cranes while the compartments of the dock are emptied. When the hull reaches the surface the floor is slipped beneath it. This done the dock is pumped dry.

In order to facilitate the towing of the dock toward the site of the accident, it is fitted with a sheet metal bow and stern which at the same time serve to reinforce the structure. The "Oberelbe" is 230 feet in length, and will lift 500 tons, while the French dock now building will be 262 feet in length, and of 900 tons capacity.

THE NEW REFUSE RECEPTACLES OF PARIS.—A SUGGESTION FOR AMERICAN MUNICIPALITIES.

BY JACQUES BOYER.

The street department of Paris has a bad reputation which it does not deserve. Foreign visitors, in particular, complain that the streets of the capital are not kept in a state of neatness worthy of the City of Light. The fact that the pavements of Paris are littered with scraps of paper to an extent unknown in London or Berlin is due, however, to the permission given by the authorities of Paris to distribute advertising matter in the streets. An attempt has been made to remedy this state of affairs by placing on the boulevards receptacles for circulars, newspapers, and other refuse. The receptacles, which are made of iron, are attached to the lamp posts, as illustrated in the photograph, and contain inner vessels of sheet iron which are periodically removed and emptied. The new receptacles are ornamental in appearance, and, as one of the photographs shows, they attract the attention of the public—which already condescends to use them occasionally and will probably do so more frequently after it has become accustomed to them. If not, the administration threatens to compel distributors of circulars to employ persons to follow them for the purpose of picking up and placing in the receptacles circulars that have been thrown on the pavement. In the Bois de Boulogne, where space is less valuable, the receptacles take the form of fixed sheet iron pillars of ornamental design, which are emptied through doors at their bases. The system is one which should commend itself to American municipalities. In some of our large cities provision is made for the disposal of waste by placing receptacles at certain points. In most cases these receptacles are made of painted or galvanized iron with no attempt whatever to palliate their native ugliness. This example from Paris shows what can be done in the way of providing really practical receptacles which are not an offense to the eye.

Fig. 1.—New Waste Baskets of Paris. Type Used on the Boulevards.

Fig. 2.—Waste Receptacle in the Bois de Boulogne.

THE NEW REFUSE RECEPTACLES OF PARIS.

A Suspended Railway for Berlin.

BY DR. ALFRED GRADENWITZ.

So rapid has been the increase in the population of Berlin and its suburbs, that the existing system of electric tramways, extensive though it be, the many omnibus lines, the Metropolitan Railway and the Elevated and Underground Railway, are unable to cope with the growing traffic. Many schemes to give the city an elaborate system of electric railways have been proposed in the last few years, some of them likely to be realized. The most interesting of these is the suspended railway, resembling in principle the famous line connecting the two cities of Elberfeld and Barmen, described in these columns on its completion. A short experimental section has been erected in Berlin for purpose of study. Before definitely committing itself to the project, the city stipulated that a trial section be constructed, so it might be in a position to estimate the effect of the structure on the general aspect of the streets.

Though the principle underlying the construction of the suspended railway is doubtless well known to our readers, it may be well to summarize briefly its leading features. Ordinary railway cars rest on wheel trucks. In this system they are suspended from the truck. Accordingly the wheels are arranged above the car roofs. By reason of this suspension a single rail answers for a track, the wheels being arranged in tandem, so that their number is reduced by half. This principle insures the following advantages: When rounding curves, the cars swing round freely, thus traversing all sinuosities quite smoothly and without any shock even at high speeds. Sharper curves may be taken than in the case of ordinary railways, the scheme therefore adapting itself more readily to local conditions. As the rails corresponding with both traveling directions are located at the edge of the elevated structure, the scheme may dispense with any very cumbersome and light-obstructing framework between the rails. Furthermore, the width of the runway is less than that of the ordinary type of railway. The streets through which the suspended railway passes are obstructed to a far less extent, which is advantageous both from a practical and esthetical point of view. The footpaths of the suspended railway are situated within the runway area, so as to take up no additional space. The contact bars and current cables are located below the footpath, and like the car motors are accessible from the footpath.

The experimental section recently completed in the neighborhood of Rosenthaler-Thor exhibits some striking departures from the design adopted in connection with the Elberfeld-Barmen suspended railway. There are no main framework girders, because the railway supports are utilized as main girders, made up as they are of continuous plate girders supported by columns in the middle of the street, between rails, at distances apart of 70 feet. Three different designs of the connection between the column and the rail supports have been suggested by three of the foremost architects, and each of them has been carried out on the experimental track. Two of these supports are designed in the form of a man carrying above his head with his arms astride the heavy load of the track, while the third has the appearance of a giant arm towering in a vertical direction, and grasping with its fist the transversal girder of the track.

Contrary to the general practice on European railways, the cars will all be of one class, with separate compartments for smokers. They are larger than most urban railway cars. Only motor cars are used, each designed, if required, as a tractor. All the electrical and motive equipment is located outside of the car body, above the roof, thus insuring the double advantage of eliminating any danger of fire to the car in the case of short-circuits, and of a perfect accessibility. The cars are provided with compressed air brakes.

The tracks are connected in a loop at the terminals. Conveniently arranged switches and sidings allow trains of variable lengths to be dealt with most rapidly. The safety of operation is assured by an automatical block system, which has given excellent results in connection with the Elberfeld-Barmen railway. It is claimed for

the suspended railway that its cost of installation, under actual conditions, will be only about one-third of that of a subway. The average speed will be about 20 miles an hour. As each car under normal conditions readily accommodates 85 passengers, the new railway will be able, on a two minutes' headway between trains, to convey 15,000 passengers in three-car trains each hour in both directions.

THE HENRY HUDSON MEMORIAL BRIDGE.

The Bridge Department of this city will soon commence the erection of a reinforced concrete arch bridge, whose proportions are so great that there is no existing masonry structure with which it can be compared. The bridge is to form an imperishable memorial of the voyage of discovery made by Henry Hudson three hundred years ago, when he sailed his little craft, the "Half Moon," up the noble river which has since been known by his name. Apart from its memorial character, the bridge will serve to carry the extension of the Riverside Drive across the western end of Spuyten Duyvil Creek. On the second floor of the bridge, immediately below the driveway, will be provision for a four-track extension of the city's Rapid Transit Subway.

The present design is not the first one to be drawn: the original movement for a memorial, inaugurated by a private association of citizens, having resulted in the production of two designs for a high-level steel bridge by Mr. A. P. Boller, of this city. One of these was for a steel arch bridge of 400-foot span, and the other for one of 825-foot span. The first was found to be impracticable, because of the impossibility of finding suitable foundations. The second plan was rejected by the Art Commission of the city of New York, mainly on the ground that a permanent monument called for a more permanent material than steel.

The Department of Bridges thereupon undertook the preparation of suitable plans, and a design was worked out upon lines suggested by Prof. Burr of Columbia University as consulting engineer, who recommended the construction of a concrete arch of unprecedented span, weight, and carrying capacity, of the general character of the handsome structure shown on the front page of the present issue. The elaborate calculations involved in determining the stresses in a bridge of this unprecedented size, and the design of the details of the structure, were worked out by Mr. Leon S. Moisseiff, the engineer in charge of the bridge under Mr. C. M. Ingersoll, the Chief Engineer of the Department. The architectural features were intrusted by the Department to Mr. Whitney Warren, of the firm of Warren & Wetmore, under whose judicious treatment the desired combined effects of dignity, permanence, and beauty have been very happily realized.

Apart from the fact that it is to be built of reinforced concrete, the size of this arch is such as to place it among the greatest arch bridges in existence, even including those that are built entirely of steel. The longest arch is the upper Niagara steel bridge, which measures 840 feet, center to center of end hinges; and the largest in contemplation is the 1,000-foot, four-track, steel railway arch designed to carry the Connecting Railway across the East River at New York. When we come to masonry or concrete bridges, however, there is an immediate drop in dimensions. The largest concrete arch at present completed is the Grünwald Bridge, of 230 feet span, at Munich. The Walnut Lane concrete bridge in Philadelphia, now under construction, measures 233 feet between abutments; but it is a vast jump from these dimensions to the span of 703 feet clear between the abutments of the Hudson Memorial Bridge. Coming to stone bridges, the most widely known of the great arches is the Cabin John arch of the Washington aqueduct, which is 220 feet in span. Other largest masonry arches are the Luxembourg, of 278 feet span, and that of Plauen, measuring 295 feet.

The general particulars of the Hudson Memorial arch are as follows: The concrete arch, which measures 725 feet in horizontal distance between the centers of the skewbacks, has a rise, center to center, of 177 feet. It consists of a huge concrete rib, which is uniformly 70 feet in width, with a thickness at the skewbacks of 28 feet, and at the crown of 15 feet. It is reinforced by forty-eight rectangular, latticed, steel members, disposed symmetrically throughout the whole mass of the concrete. Each of these members consists of four 8 x 8-inch angles, latticed on all four sides. These members are themselves braced together by a system of vertical and diagonal struts and ties, as shown in our sectional view. The double-deck floor of the bridge is supported upon the main rib by reinforced, rectangular, concrete piers, the reinforcement consisting of rectangular latticed posts, which are carried down to the steel reinforcing ribs of the main arch and securely riveted thereto. These piers consist each of a pair of concrete shafts 8 feet thick measured in the direction of the axis bridge, and 22 feet wide, with a space of 26 feet left in the center of the bridge between them. In each of the piers are six of the steel latticed columns above referred to; and the twelve steel columns of each pair of shafts are connected at the foot by four transverse plate girders, which themselves rest upon the reinforcing ribs of the main arch; thus securing a satisfactory distribution of the superstructure load to the main arch ring.

The approaches to the main arch consist of seven 108-foot, semi-circular arches, three on the south side and four on the north. These approaches and the monumental piers, 108 feet in width and 180 feet in height, which flank the main arch, will be built of concrete, generally with little reinforcement.

The upper deck of the structure will have a clear width of 80 feet between the balustrades, with provision for a 50-foot roadway and two 15-foot sidewalks. The lower deck will have a clear width of 65 feet between the inside of the walls; and it will be occupied ultimately by four railroad tracks, besides pipe galleries for the placing of electric cables, and water and gas mains.

It is essential to the permanence of a fixed arch of this character that the foundations be absolutely secure; and, fortunately, the geological conditions of the site selected for the bridge are very favorable. On both sides the rock slopes rapidly upward to an elevation of some 200 feet above mean high water. The foundations for the main arch are practically all on dry land and upon hard rock. The pressure on the foundations will be far below the bearing resistance of the rock; and, for the thrust of the arch to result in any movement, it would be necessary for the hills back of the foundation to be displaced.

The unprecedented size and weight of this arch (unprecedented, that is to say, in masonry construction) has led to some loose talk and altogether unfounded apprehension as to the stability of the bridge when it is completed; and it has been suggested that although the behavior of reinforced concrete is well understood when it is applied to bridges of moderate span, there may be new and unsuspected elements of danger introduced when concrete is used in a bridge of these huge proportions. As a matter of fact, in the design of the structure, careful computation has been made of every imaginable kind of stress which it may have to bear, such as those due to changes of temperature, and the possible shrinkage of the concrete after the arch has been swung free from its falsework, and the stresses caused in the arch by its greatest distortion from the original curve. Provision has also been made for unusually high moving loads both for the upper and lower floors of the bridge, the total moving load on the arch being taken as 15,000 pounds per linear foot of the bridge, which is about the same as that assumed for the Manhattan or Blackwell's Island bridges, which will carry the heaviest loads provided in long-span bridges up to the present time.

The steel skeleton reinforcement has been worked out in such thorough fashion, and is so well disposed and thoroughly connected together, that it would form a self-supporting arch of itself, capable of carrying no inconsiderable load, and possessing great inherent rigidity against deformation. This steel skeleton performs two functions. First it carries a portion of the load, said portion being determined by the relative elasticity of the concrete and the steel; and, secondly, it ties the concrete together and causes it to act as one homogeneous mass. Moreover, the method of reinforcing with box-like units bands the concrete together and furnishes it with a lateral strength, the value of which in resisting compressive strains is well known. It should be stated here that the design of the main rib is such that it will be called upon to resist compressive strains only.

The conservative methods employed in designing this bridge are shown by the compressive stresses provided for. These will not be allowed to exceed 20,000 pounds per square inch in the steel which has an elastic limit of 30,000 pounds; while the greatest possible stress, taking all possible effects into consideration, to be allowed on the concrete has been fixed at 750 pounds per square inch, which is one-fourth of the least strength of the concrete three months after it has been set in place. It is believed by the engineer that the final design will reduce this stress to 700 pounds. Because of the progressive methods employed in the building of the bridge, however, the maximum stress will not come upon the concrete until between two and three years after the great arch rib has been completed; by which time the concrete will have hardened to a compressive resistance of at least 6,000 pounds per square inch, or over eight times the allowed unit stress.

Special attention is being given to the design of the falsework, which will be planned, not by the contractors, but by the Department's own engineers. It will be made unusually strong; great care will be taken in securing stable foundations; and the centering will be provided with adjustable supports. After the completion of the arch rib, it will be kept on the falsework for at least four months before striking the centers. The rib will be kept wet during this time by a sprinkling system, and it will be protected from the sun and the wind. A cement-and-concrete testing laboratory will be established on the building grounds, and a corps of young graduate engineers will be employed to watch the work and see that the concrete is mixed in its proper proportions, and thoroughly deposited in close contact with the steel reinforcement.

When we bear in mind the excellent character of the rock foundations; the great care with which the computations and design of the bridge have been made; the large amount of carefully-observed data regarding the behavior and strength of concrete in bridges which is available; and the expert oversight which will be given to every part of the erection, we have every reason to be assured that in the Hudson Memorial Bridge, as completed, New York city will possess a monument which will be as enduring as the Pyramids themselves.

Caffeinless Coffee.

BY K. WIMMER.

It is a curious paradox that the most popular stimulants are usually taken less for their stimulating effect than for their agreeable flavor. Connoisseurs do not judge cigars by their percentage of nicotine, wines by their alcoholic strength, or coffee by the quantity of caffein it contains. It may even be asserted that persons who are passionately addicted to these stimulants find their narcotic effects unpleasant and would be glad to have them eliminated.

Many attempts have been made to free coffee from its more or less poisonous alkaloid caffein, without injuring its flavor, but only recently has any noteworthy success been attained. The problem is a very difficult one. The coffee bean is a hard seed with thick-walled cells. Until recently it has been found impossible to extract any appreciable quantity of caffein from unground coffee.

Ether, for example, dissolves about 16 per cent of finely pulverized unroasted coffee, including nearly all of the caffein, but from the whole bean it removes only 1/3 per cent of extractives, including 1/50 per cent of caffein. This shows that caffein solvents penetrate the bean with great difficulty.

Hence the coffee must be subjected to a preliminary treatment which will make it more permeable by the solvent, without altering the shape or appearance of the bean, and a solvent must be found which will readily dissolve the caffein, without removing from the raw coffee any substance which is necessary for the development of the aroma on roasting or the flavor and color of the infusion.

Both of these objects have been accomplished by a recently invented process, which removes all but a trace of the caffein together with a very small quantity of brown, wax-like extractive matter, but leaves unaltered all the ingredients which affect the flavor, aroma, and appearance of the coffee. In this process only vapors and volatile liquids are employed, so that no foreign substance is added to the finished product. The quantity of caffein remaining unextracted, from 1/20 to 1/5 per cent, is too small to exert any injurious physiological effect.

In general terms, the process is carried on as follows in a factory of the Kaffee Handels Aktiengesellschaft: The raw coffee first passes through cleaning machines, which removes shells and other impurities. Thence it passes successively through the preparation chamber and a battery of six diffusion tanks, each holding 550 gallons. In these vessels the coffee comes into contact with a slowly moving current of solvent, which gradually extracts the caffein. The time occupied in the extraction varies with different sorts of coffee. From the extracting vats the coffee goes to revolving drums for a treatment which, like the preparatory treatment, is a trade secret, thence to drying and cleaning machines. It is then ready for roasting.

Very little, if any, difference in taste, aroma, or chemical composition can be detected between coffee so treated and coffee of the same variety in its natural condition.

Many tests of the physiological effects of the extracted coffee upon persons in good and ill health have been made in sanatoria and by physicians in private practice. Patients suffering from nervous and heart disease, and peculiarly susceptible to the action of caffein, have used strong infusions of the extracted coffee for months without ill effect. In parallel experiments with the extracted coffee and untreated coffee of the same sort, in equal quantities, the well-known unpleasant symptoms of caffein stimulation, including increased heart action, sense of fullness in the head, etc., were well marked in the one case and entirely absent in the other.

It appears, therefore, that caffeinless coffee possesses advantages that must appeal to every physician who is familiar with the injurious effects of caffein in heart disease, nervousness, insomnia, anemia, and certain diseases of the stomach and bowels. Healthy persons may also prefer to use a coffee that can exert no deleterious influence and yet retains the full flavor of natural coffee.—Translated for the Scientific American from Umschau.

Correspondence.

The Number of De Forest Stations.

To the Editor of the SCIENTIFIC AMERICAN:

The New York Maritime Register of March 11, 1908, prints an article under the heading "Wireless Statistics," giving your paper credit for same, in which the DeForest system (which system is now the United Wireless Telegraph Company) is apportioned but 6 per cent of the total number of wireless telegraph stations.

From the "List of Wireless Telegraph Stations of the World," published by the Bureau of Equipment, Navy Department, and corrected to August 1, 1907, it is shown that the DeForest system has about 28 per cent. UNITED WIRELESS TELEGRAPH COMPANY,

C. C. WILSON, President.

New York, March 17, 1908.

The Soap-Nut Tree.

To the Editor of the SCIENTIFIC AMERICAN:

Your kindness in publishing the article on the Soap-Nut Tree Seeds in your last issue is highly and gratefully appreciated. There is, however, a lack of information which may cause the missing of my aim. I do not ask publicity for the sake of self-glorification, but only for the sake of usefulness to the success of my work.

First, my address is not given in your article and this may, of course, either provoke useless correspondence, or abstention from parties who may desire to apply for seeds.

Second, there must be some rules for application, and these are set forth in my communication to you. In other words, the free distribution is extended to the parts of the Southern States where the soap tree can be grown outdoors and to parties in all the other States who have conservatories or hot-houses, and mention of this must be made in the application.

Third, five cents for mailing and packing expenses must be sent with the application.

I hope that you will pardon me if I ask that you kindly refer to the above in your next issue, if possible, as now is the most propitious time to plant the seeds. E. MOULIÉ.

Jacksonville, Fla., March 30, 1908.

Unjust Criticisms of the United States Navy.

To the Editor of the SCIENTIFIC AMERICAN:

I want to congratulate you on the very excellent article appearing in recent issues of your journal, in which such satisfactory and clearly-presented evidence to controvert the statements made by Reuterdahl in his derogatory comment on the vessels of our navy appearing in the January McClure's is offered. Certainly this reply decidedly is the best that has yet appeared, and having the authoritative weight of a scientific journal like yours, it should receive general exploitation, in order that the public may be acquainted with the actual facts.

Reuterdahl's article has had widespread reading, and is calculated to give the general public a very erroneous conception of the true status of our warship design. Former Chief Draftsman Brewer, in the last issue of Harper's Weekly, has a popular article refuting a number of Reuterdahl's statements, but his article does not go into these matters as analytically as does yours, and he overlooks several points of great weight which your contributor makes.

It is very regrettable that an article like Reuterdahl's should receive popular circulation, for many of his readers will never see evidence offered in rebuttal, and it is a difficult enough matter now to induce Congress to make sufficient appropriations to continue the upbuilding and maintenance of our navy; and with prejudice against further appropriations increased by such inflammatory material as offered by Reuterdahl, the efforts of those who seek the safety of our country and immunity from war by securing the provision of an adequate navy are greatly handicapped. Reuterdahl's article is not going to do good, but actual harm to the navy. RICHMOND MCKINNEY.

Memphis, Tenn.

An Odd Accident to a Furnace Stack.

To the Editor of the SCIENTIFIC AMERICAN:

What the writer believes will appeal to your readers as a peculiar and interesting fact in connection with steel stacks recently came within his observation.

Our open-hearth furnace stacks are 100 feet high, 4 feet 8 inches inside diameter, of the self-sustaining type, being lined with fire brick. The upper 39 feet of each stack has 56-inch sections of 3/16-inch plates, the sections having a 2-inch lap, secured by fifty-six ⅞-inch rivets.

It was recently discovered that the upper 35 feet of No. 4 stack, which has been in use about three years and a half, had apparently raised an inch and a half, shearing all the rivets holding the two sections at that particular point. To be exact, the raise was 1⅝ inches on the east side and 1½ inches on the west side, leaving a lap of ⅝ inch and ½ inch on the respective sides, making the stack have a perceptible lean toward the west.

This phenomenon has taken place since the spring of 1907, as the stacks were last painted then, and the portion of the section which has "climbed" is not painted.

I have yet to find a stack builder who has seen a parallel case. There is no indication of a similar condition on any of the sections of our other stacks.

The only explanation which seems to fit the case is that the brick lining in expanding became fouled on the laps or rivets, but it appears strange that this expansion of fire brick would be sufficient to do the damage described. As furnace No. 4 is still in commission, it is impossible just now to determine the exact cause. R. S. BULL.

Granite City, Ill.

Halley's Comet.

To the Editor of the SCIENTIFIC AMERICAN:

The statement made by Prof. Russell in the SCIENTIFIC AMERICAN that Halley's comet may be photographed before the end of this year adds interest to the approach of that body. It is now probably nearer to us than Saturn is. For the benefit of those amateur astronomers who would like to watch for the appearance of this comet, I have made the accompanying drawing. The comet's apparent position is shown for every three months from July, 1908, to October, 1909, after which time it will probably be visible to the naked eye. Its course has been plotted from the ephemeris of O. C. Wendell, based on the elements of Pontécoulant, who gives May 16, 1910, for the time of the comet's perihelion passage.

The predicted positions are as follows:

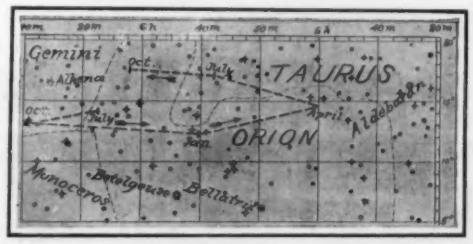
July 1, 1908—In Orion, near his right fist.

October 1, 1908—In Gemini, close to the double star Xi, in the right foot of Pollux.

January 1, 1909—In the head of Orion, 5½ degrees north of the double star Betelgeuse.

April 1, 1909—In Orion, one degree south of a pair of fifth-magnitude stars.

July 1, 1909—In Taurus.



COURSE OF HALLEY'S COMET.

The dotted lines connect the predicted apparent points that Halley's comet will occupy in the heavens up to October 1, 1909.

October, 1909—In Orion four degrees north of the starting point.

Halley's comet is the most famous in history. Its period is about 75 years. Its last return was in 1835.

JOHN CANDEE DEAN.

Indianapolis, Ind., March 18, 1908.

A Cause of Derailments.

To the Editor of the SCIENTIFIC AMERICAN:

I have been more or less interested in the occasional discussion that you publish regarding railway derailments. It is generally acknowledged that the majority of such accidents is due to initial derailment of the tender.

This condition of affairs is variously ascribed to its comparative lightness, its badly-proportioned trucks, its spring arrangement, its shortness, etc. There is, however, one element that I believe to be a most potent factor, and one that singularly remains unmentioned.

I refer to the nature of its load. A large portion of that load is a liquid load—one capable of vibration with a considerable moment of inertia, and—most important—with a definite time of vibration. It is clear that if a series of lateral impulses, though they be quite insignificant apparently, have the right length periodicity, they would generate in this liquid mass a considerable vibration.

It is clear that each additional impulse would add to this vibration and to its momentum. It is true that the joints, especially if they were laid broken-jointed, would be an ideal source of lateral impulse, the case being not unlike the military company and the bridge, where a mass of men whose static load might be quite incommensurate to safe working load of the structure could wreck the structure by the side thrust of this number of men keeping step. In conclusion, I believe that by properly baffling the tank to break up this vibrating space, it would be impossible to cause enough vibration under any speed conditions or load conditions to in any case lift one side of the truck from the rail. I believe a discussion of this point would be of interest. F. W. L. PEEBLES.

St. Louis, February 4, 1908.

Official Meteorological Summary, New York, N. Y., March, 1908.

Atmospheric pressure: Highest, 30.61; lowest, 29.55; mean, 30.10. Temperature: Highest, 75; date, 27th; lowest, 23; date, 10th; mean of warmest day, 66; date, 27th; coolest day, 27; date, 1st; mean of maximum for the month, 48.3; mean of minimum, 34.5; absolute mean, 41.4; normal, 37.7; excess compared with mean of 38 years, +3.7. Warmest mean temperature of March, 48, in 1903. Coldest mean, 29, in 1872. Absolute maximum and minimum for this month for 38 years, 75 and 3. Average daily excess since January 1, +1.0. Precipitation: 2.15; greatest in 24 hours, 0.63; date, 18th and 19th; average of this month for 38 years, 4.03. Deficiency, —1.88. Accumulated deficiency since January 1, —0.23. Greatest March precipitation, 7.90, in 1876; least, 1.19, in 1885. Snowfall, 3.5. Wind: Prevailing direction, N.W.; total movement, 8,900 miles; average hourly velocity, 12 miles; maximum velocity, 57 miles per hour. Weather: Clear days, 10; partly cloudy, 8; cloudy, 13; on which 0.01 inch, or more, of precipitation occurred, 13. Fog (dense), 2d, 23d. Thunderstorms, 15th, 19th.

Our "Wanted to Buy" Column.

Each day our mail brings us innumerable inquiries for articles of all kinds, from the smallest novelty to the complicated machinery used in manifold industries. Where the article is advertised in the SCIENTIFIC AMERICAN, it is of course easy to find the same by a reference to our handy Manufacturers' Index, which has just been issued for free distribution, but there are many cases, however, where we are unable to give the address wanted. We then enter the correspondent's name and address in a book and give his inquiry a number. The inquiry is then published in the Classified Advertising Column, being interspersed with the classified advertisements. Manufacturers see these inquiries, and write us for the name and address of the correspondent, which is given. Thus buyer and seller are brought into business relations, we merely acting as a clearing house for our readers. There is no expense connected with this service, but it should be thoroughly understood that the free inquiries are only for buyers; the advertising columns are always open for sellers. Our readers are requested to avail themselves of this opportunity.

The Appellate Division of the German Patent Office has within the past few days handed down an interesting decision affecting the future development of wireless telegraphy and telephony. The decision has reference to the Lichtbogen-Unterbrecher patent of the well-known Berlin inventor, Ernst Ruhmer, which materially affects the Poulsen system for the propagation of continuous electrical waves. The company which is developing the Poulsen system admit that several Poulsen stations are working under the Ruhmer system. The German Poulsen patents relating to electrical wireless telegraphy and telephony and the German Ruhmer patents relating to electrical Lichtbogen-Unterbrecher have within a few days become the property of the C. Lorenz Aktiengesellschaft, Berlin, who will develop the patents in Germany. This amicable arrangement will prevent the contest between the two inventors which was feared.

The long series of experiments relating to building stones conducted by Prof. Hanish at Vienna some time ago has been supplemented by additional tests, published in the current issue of the Mitteilungen der K.K. Technologischen Gewerbe-Museums in Vienna. These further experiments with some 267 varieties of building stones, from all parts of the Austrian empire and from adjoining countries, comprise careful determinations of the weight of a cubic centimeter of each: the strength under compression; the resistance to frost—tested by freezing and thawing each sample for twenty-five times consecutively—and the volume of water absorbed by each specimen. These facts, which are set out in tables, give the results obtained by the professor down to the end of the year 1906, and furnish valuable data for studying the properties of all the most commonly employed building stones and stone used for road-making purposes.

The Current Supplement.

By far the most important article in the current SUPPLEMENT, No. 1684, is that on electrical machinery and steel making, by Mr. W. T. Dean, in which it is clearly set forth how large a part is played by electricity in the reduction of iron ore. Mr. H. W. Pearson's paper on the basis for a new geology is completed. Dr. Koester tells how archæologists work, and gives not a little information on the engineering side of archæology. Of technological interest are the contributions on wood distillation and the utilization of paper and pulp mill wastes. Mr. George E. Walsh describes very clearly how a fireproof garage should be constructed. The report on English commercial vehicle tests is published.

THE RECENT WORK OF LUTHER BURBANK.

BY RILEY M. FLETCHER BERRY.

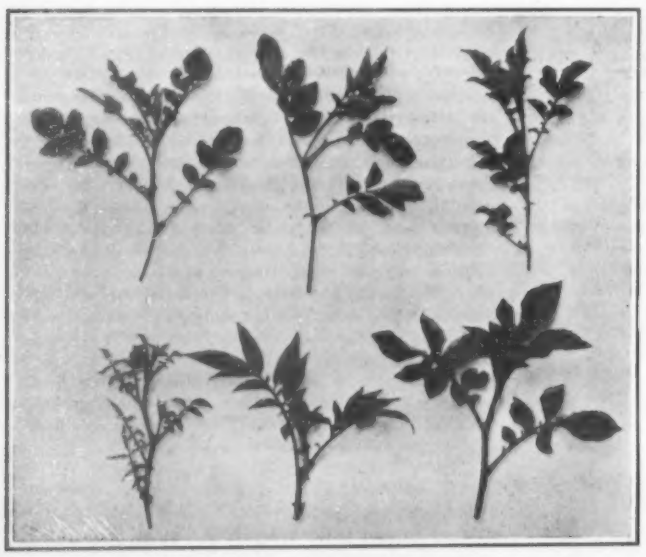
For over twenty-five years we have heard of the Burbank potato, but very few could have imagined what lay behind that name and into what greater meaning it would grow. Potato hoeing is usually considered a dull, tiresome task, but as a boy Luther Burbank took a different view. He looked at his home potato patch, in New England, as a fascinating problem. The result was a new and improved variety of potato which, when he was eighteen, he sold to a seed-house for $150. This was practically Mr. Burbank's first experiment, and his success since then in developing principally the ideally beautiful in fruits and flowers makes it all the more interesting that again he is experimenting with the homely potato. For the last several years Mr. Burbank has planted and propagated potatoes on an immense scale, and now, with ten thousand kinds—his own hybrids—he diligently studies and works to perfect the white tuber in size, form, and flavor.

Until recently it was almost impossible to obtain either tubers or seeds of the "Irish" potato in its original, wild form, from its ancient habitat in South America. There, high up in the peaks of the Andes, the potato plant still finds food on the grim, gaunt rims of extinct volcanoes, and slowly, in two years' time, develops into one shapeless tuber. But the Indians of those regions are as wild and resistant as the potato, and fiercely prevented encroachments by white men until civilization took the form of whisky. It is true that the seeds are washed down the sides of the mountains, but the plant changes form in its descent, finally becoming the worst weed the people have. More than ten thousand seedlings, Mr. Burbank says of this weed, are found upon a single acre. He has been importing specimens of the original, wild form from off the coast of Chili and crossing them with others of his cultivated types; from the results selecting the best for further development. Of the new varieties already obtained Mr. Burbank says some are almost as sweet as sweet potatoes. Certainly the world will await with great curiosity and equal faith the final results of this present series of potato experiments. One of the most important examples of the work to which Luther Burbank has devoted himself is the development of a plant-friend of his earliest years—the opuntia; for, as he expresses it, a thornless cactus was one of the first pets he had. There are hundreds of varieties of the opuntia, or prickly pear—so many that it has been a difficult matter to classify them; and they grow in almost as many different portions of the globe. Commonly supposed to be naturally thorny, in reality the opuntia was originally spineless and in addition possessed leaves. Lack of rain in the wild regions in which it spread caused it gradually to discard its leaves and substitute its stems (enlarged) as moisture-gatherers. And in time thorns developed as the ravages of hungry animals increased, for nature usually gives her offspring some means of defense. Some varieties of the wild thornless cacti are still to be found in Hawaii and other countries, growing in crevices of rocks or other spots inaccessible as feeding grounds. But in the places where forage is most needed, upon millions of arid acres all over the world, the opuntia's spines are most huge and fierce, its fine, sharp needles most deadly. In periods of drought and famine hundreds of thousands of animals have perished on Texas tracts and other wide stretches for lack of food and water. At its best the prickly pear means both, but even where ranchmen singe the cactus for their cattle the spines cannot be entirely destroyed, so that in such instances animals suffer and die as well as when driven, desperate, to the unsinged plants.

Various Foliage of the Original Wild Potato From the High Mountains of Chile, Peru, and Central America.

Our own government and scientific men of other countries have taken this work of Mr. Burbank's very seriously, since it has been found that the cultivated, spineless opuntias he has bred will withstand adverse conditions of climate or soil quite as well as those native to desert regions and at the same time produce ten times more food than the average type of wild opuntias. But it is not only in desert regions that the thornless cactus is practicable and useful. The usual farm-crop of forage is about twenty tons per acre; the new varieties, Mr. Burbank says, will produce 200 tons per acre, that is, under favorable conditions on good cultivated soil; and upon gravelly or rocky stretches where nothing now brings returns to the farmer this easily grown fodder-crop will assure excellent results.

Although in one sense the thornless opuntias have virtually been brought to perfection, Mr. Burbank is still at work upon them, developing another phase of their usefulness, and one of the very latest things he has accomplished is to prove that the seeds may be



The Hybrid Walnut "Royal," Second Generation Showing Variations in Leaves.

Burbank's New Himalaya Blackberry. Its Ancestor Was a Seedling Sent from the Far East.

Young Seedling Semi-Thornless Opuntias Bearing Their First Crop of Fruit.

Three-Year-Old Hybrid Chestnut Trees Bearing Their Third Crop of Fruit.

THE RECENT WORK OF LUTHER BURBANK.

made to go the way of the thorns. He has now two kinds of prickly pear whose fruits are practically seedless. The few still in evidence are almost as small as tomato seeds now, he says, and growing fewer all the time. The fruit is of value to stock from its juiciness and from the amount of sugar it contains (14 per cent, more or less). Also, the best cactus contains 2½ per cent of fat, while others contain only a small fraction of one per cent. He reckons that on the poorer types of soil the average crop of fruit alone is 18,000 pounds per acre. As food for man the fruit is not new, but the type oftenest found hitherto has been rather insipid—not unpleasant, yet distinctly peculiar in its flavor and of mucilaginous consistency. The wild specimens have chiefly been valued to quench thirst, yet in a number of the warmer countries they are eaten to some slight extent as a dessert-fruit, in marmalades, and are used for coloring ices, jellies, and other concoctions, the usual color being crimson. Mr. Burbank, however, has bred both crimson and yellow opuntias which he considers superior to the banana in flavor and they are delicious, variously prepared. One novel use to which both fruit- and leaf-juice are put is as an addition to whitewash, since it acts as a preservative against exposure to inclement weather.

Mr. Burbank now has growing under his own observation the original wild type of grass (native to Mexico) from which gradually developed our modern maize. However, he cannot achieve results so quickly with this cereal as with many other forms of plant life, for corn, like cactus, is very persistent in clinging or reverting to type. Compared with the work necessary in developing these two plants he considers his development of the wild yellow California poppy into an orange, a crimson, and a blue poppy comparatively easy.

Some of Mr. Burbank's most wonderful work has been with plums, creating among various delicious new types, the stoneless blue Miracle Plum. In the new Santa Rosa, Gaviota, Formosa, and Vesuvius plums—of reddish shades—only just placed upon the market, the pits are comparatively *nil*. Of the new fruit created by crossing the plum and apricot, the Plumcot, there are also already new varieties, for the famous plant-breeder does not halt at the first step but experiments ceaselessly.

An example of Mr. Burbank's development of various berries is his new Himalaya blackberry (its ancestor a seedling sent from the Himalayas to the plant-scientist) each plant of which will yield eighty pounds of fruit each year, keeps well, and, according to his own judgment, is exquisite in quality.

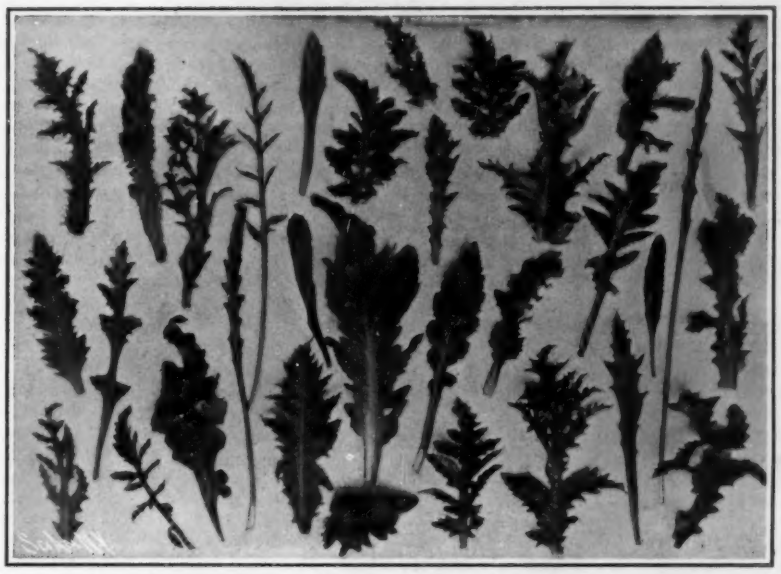
Other experiments being carried on at Santa Rosa and the proving grounds at Sebastopol have to do with forage grasses, grapes, apples, cherries, chestnuts, and walnuts. The chestnut's richness as a starch-food is extremely valued in the Orient and southern Europe. Foreign chestnuts are as a rule larger than ours, but Mr. Burbank has produced varieties far superior to any of those yet known and has thousands of hybrids which he has developed from Italian, American, Chinese, and Japanese species.

One of the unusual ideas embodied in the Burbank experiments is that of developing hardy types of tropical plant life, adapting them to colder climates. The banana is a most delicate fruit, the succulent leaves and stalks of the plant being extremely susceptible to frost. Yet Mr. Burbank expects to render it immune from cold and from the plantains (type of the species) he is now growing evolve a type which can be successfully raised by even New England growers out of doors.

Mr. Burbank's Shasta daisies (equal to chrysanthemums), his immense and miniature specimens of calla-lily breeding, his verbenas with odor of trailing arbutus, his new crested *Heuchera cristata*, his enormous, almost ever-bearing, crimson rhubarb, his improved prunes, and other creations are wonderful, but those with an eye for both the practical and the beautiful will consider that few of his productions equal or surpass his two new hybrid walnut trees, the Paradox (the result of a cross between the California and the Persian or English walnut), and the Royal black walnut, from the California and the American black walnut. Both are essentially ornamental shade or forest trees, and no trees of the temperate zones can approach them in rapidity and luxuriance of growth. The fruit of the Paradox is not of any commercial importance. The Royal black walnut bears more abundantly and its nuts are larger and better than the old-fashioned black walnut, but their fruit is of mere secondary importance, for it is as lumber and shade that these trees were created and are pre-eminently adapted. The grain of their wood is fine, compact, hard, and durable and susceptible of the highest polish. That of the Royal is very dark and is handsomer than that of the American black walnut, more nearly approaching mahogany. The Paradox is lighter in color but is also beautiful and "silky" in appearance. As our native black walnut forests have been almost entirely destroyed and the tree is slow in growth, foliage-loving foresters and practical lumbermen feel that the Burbank walnuts are almost priceless in value to the world.

In addition to his constant experimental work Mr. Burbank is now writing ten volumes for the Carnegie Institute, daily dictating to three stenographers. And because of Mr. Burbank, Santa Rosa now has three other busy scientific men as residents, for Prof. H. B. Humphrey and Dr. LeRoy Abrams, both botanists and members of the Stanford University faculty, are assisting Dr. Mays Martin (from the East) who has charge of the work of editing the ten-volume record of the Burbank botanical discoveries. With all this Mr. Burbank yet finds time once in a while to address some important public gathering, as the Irrigation Congress or the Teachers' Institute. He has identified himself so thoroughly with educational interests by his book, "The Training of the Human Plant," that it was a happy thing for the teachers that he could personally appear before them. This modern apostle of the practical and the beautiful is also the loving apostle of childhood, with ideas just as radical and just as sensible concerning children as concerning plants.

But those who achieve greatness pay the penalty. The world restlessly seeks the secret of happiness and success persistently, and naturally wishing to see such celebrity as has won both, on his native heath. Therefore Mr. Burbank is sought by thousands who do not realize that he cannot spare time and strength from his work. Hard work and brilliant achievement are

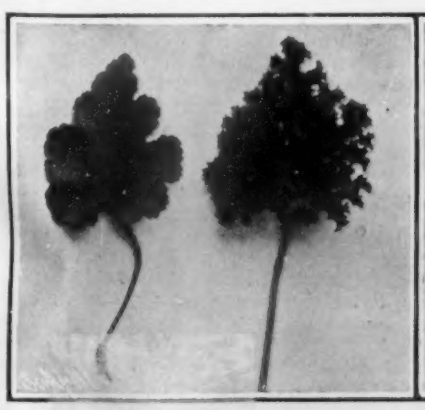


Strange Variation in Leaves of Poppies Produced by Crossing the Annual and Perennial Species.

Fourteen-Year-Old Royal Black Walnut.

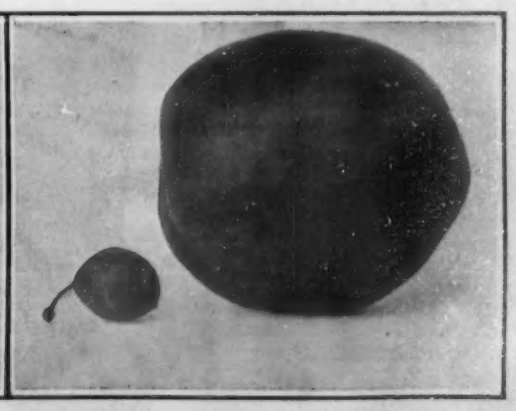
A cross between the American black walnut (*Juglans nigra*)) and the California walnut (*J. Californica*). Courtesy of Mr. Burbank.

Perennial Sweet Vernal Grass, Showing Variations Obtained by Selection.



Original Heuchera Leaf and Created Heuchera Cristata Grown From the Former by Selection Only.

Curious Seed Pods of Hybrid Poppies When Perennials and Annuals Are Crossed.



Blossoms of the Smaller Plum (the Common Beach Plum) Were Pollenized by a Japanese Variety and Produced the Big Plum 400 Times as Large as Its Parents.

THE RECENT WORK OF LUTHER BURBANK.

almost inseparable companions. And so it happens that nearly every friend who writes of Luther Burbank feels it his duty to protect him by quoting the notice now placed at each gate of the Burbank grounds ("By the Friends and Relatives of Luther Burbank"): "Positively no visitors allowed. Warning! Any person entering or trespassing on these grounds will be prosecuted," and portions of the circular published for the information of the public, stating that the public has no moral, legal, or other right to invade his grounds, his home, his private office or his laboratories; and that Mr. Burbank has nothing for sale; he is not a nurseryman, not a florist, not a seedsman, not a dealer and not a raiser of any plants or seeds for sale.

THE USE OF BALLOONS FOR THE PREVENTION OF HAIL.

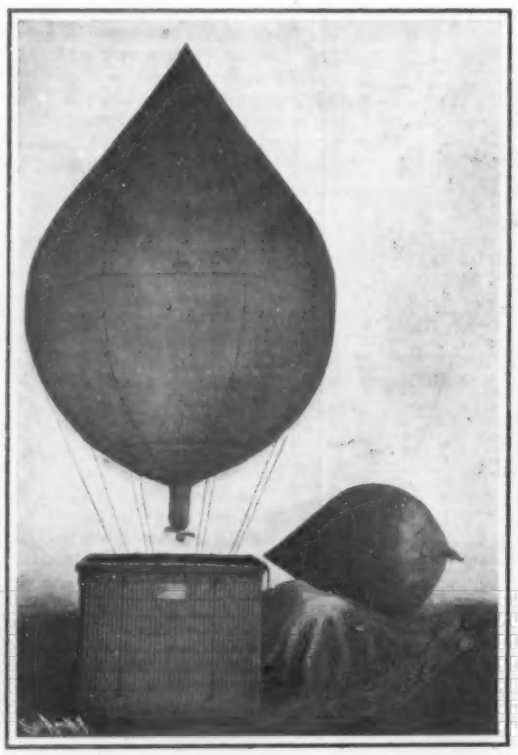
BY THE BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Because of the terrible damage wrought by hail in some parts of Europe, scientists have directed their attention to designing a means by which the outbreak of hail could be prevented, and some success has been obtained by the use of hail guns, firing a shot of either gunpowder or acetylene against the hail cloud and thus dispersing it.

Though a number of societies for the installation of these guns have been founded, both in Southern France and Italy, their usefulness is not universally accepted. Other experimenters have tried rockets, and these have been adopted at some places.

Now, it would probably be more efficient to attack the cloud as it were from its very seat, than to act upon it from the ground. In fact, as far back as 1847 Arago and Dupuis - Belcourt suggested the use of a small captive balloon made entirely of copper, so as to be impervious, and the surface of which would be covered with sharp points. The suggestion was not tried.

The same idea has now been taken up by two Belgian aeronauts, Capt. Marga and Mr. Adhémar de la Hault, who however use a free balloon, carrying some powerful explosive, such as dynamite or guncotton, which is ignited by some attachment as soon as the balloon has penetrated into the hail-carrying clouds. The balloon used by the experimenters is pear-shaped and of three cubic meters capacity. When filled with hydrogen gas it has an ascensional force of more than four pounds. Five hundred grammes of an explosive, with a nitro-cellulose basis, designed by Capt. Marga, are carried, together with a slow match.



An Experimental Balloon with a Basket for Recording Instruments.

Dispatching an Experimental Balloon Loaded with a Nitro-cellulose Explosive.

THE USE OF BALLOONS FOR THE PREVENTION OF HAIL.

Experimental ascents have proved successful, and show that in the case of a gathering storm-cloud, it will be possible to so time a charge and direct a balloon as to obtain an explosion in a favorable position for dispersing the clouds. The explosive, suspended at some distance below the balloon, does not injure it, and the latter may be recovered and used again.

Some more extensive experiments will shortly be undertaken at the meteorological station at Mogimont, which has been recently installed by Mr. de la Hault, especially for the purposes of investigating the behavior of thunder storms and hail.

According to a consular report, Russian and American lubricating oils are sold nearly as cheaply in Spain as in the United Kingdom. One large Russian firm keeps a depot in Barcelona, and imports in tank steamers, selling duty paid to its clients. Before the convention with the United States, and under the old tariff, lubricating oils from the United States paid 10 pesetas more per 100 kilos than those entering under the minimum tariff. Resort was therefore often had to the expedient of denationalizing American oil by shipping it to continental ports, changing the marks of the consignments, and re-shipping to Spain.

TRACHODONT, THE DUCK-BILLED DINOSAUR.—SKELETONS OF PREHISTORIC REPTILES MORE THAN THREE MILLION YEARS OLD.

BY BARNUM BROWN, OF THE STAFF OF THE AMERICAN MUSEUM OF NATURAL HISTORY.

Recently there was placed on exhibition in the American Museum of Natural History in New York city two unusually complete skeletons of that interesting group of extinct reptiles known as dinosaurs.

Many single skeletons representing a variety of these creatures have been mounted at different times in museums of this country and Europe. But the fortunate acquisition by the American Museum of two nearly complete skeletons of the same genus made possible a notable advance in the method of exhibiting fossil animals, namely, the mounting of two specimens in a single group, each in a characteristic attitude, with accessories suggesting the natural surroundings of the animal during life.

The conception of this group takes us back more than three millions of years to the Cretaceous Period, during which this variety, the Trachodonts, were one of the most numerous of the various kinds of dinosaurs. While two of them are feeding along the marshes, one is startled by the approach of their carnivorous enemy, the *Tyrannosaurus*, and stands on tiptoes to better overlook the foliage. The other, unaware of danger, continues peacefully to crop the foliage. It is not such a far cry to picture a scene of this kind, even in that remote period, when aided by complete skeletons, impressions of leaves, rushes, tree trunks, and fruits that lived during the same epoch. Indeed, the left hind foot of the erect specimen bears three gashes made by some carnivorous enemy, a possible result of such a scene.

The Trachodonts lived near the close of the Age of Reptiles in the Upper Cretaceous Period. They had a wide geographical distribution, their remains being found in New Jersey, Mississippi, and Alabama, but oftener in Wyoming, Montana, and the Dakotas.

Some suggestion of the great age of these specimens may be gained from the fact that since the animals died, layers of rock aggregating several thousands of feet in vertical thickness have been slowly deposited along the Atlantic coast, during a period of time that has been estimated by geologists as covering more than three million years.

In the western States there are restricted areas wholly or in part devoid of vegetation. Hills and valleys alike are banded in soft neutral tints or vivid colors as the case may be, and composed of alternating beds of clay and sandstone, the resulting accumulation along prehistoric marshes and river flood-plains. During deposition the material was gradually built up evenly, but as soon as accumulation ceased, the erosive forces wind, frost, and rain combined to sculpture the sediments into the present picturesque "Badlands." It was in these terraced badlands near Crooked Creek, central Montana, that the erect skeleton was found in 1904. Two ranchmen were riding among the hills looking for cattle one day, when rounding a knoll one of them espied a large skeleton partly uncovered.

"Look what a carcass!" he exclaimed, reining up his horse.

"It's the biggest buffalo I ever seen," said his companion.

"It ain't no buffalo, it's one of them mastodons that bug-huntin' outfit's looking for"; and to prove his assertion, jumped to the ground and kicked off all the bones in sight, thereby proving by their brittle nature that they were stone, and not buffalo bones.

A neighbor who had heard of the find, and knew that it was valuable, "traded" Mr. H—— a six-shooter for his interest in it. The six-shooter wasn't a good one, and was eventually "swapped" for a pinto pony which Mr. H—— now calls "Dinosaur." The specimen was purchased and excavated by the American Museum expedition of 1906 and mounted in 1907, thus ending the events of a long and checkered career.

The companion skeleton, mounted in a feeding attitude, was found near the Moreau River, South Dakota, in badlands of the same age. It was discovered by Dr. J. L. Wortman and Mr. R. S. Hill, collectors for Prof. Cope, in 1882, and was one of the principal specimens in the Cope Collection, which through the generosity of Mr. Morris K. Jesup, the late president, was purchased and given to the American Museum.

The Trachodonts were kangaroo-shaped reptiles with long hind legs, reduced fore legs, and a long tail. That they were strictly herbivorous is clearly shown by the elaborate dental apparatus. The mouth was expanded in a broad duck-like bill, which during life was covered with a horny sheath as in birds and turtles. In each jaw there were from 45 to 60 vertical and from 10 to 14 horizontal rows of teeth, or more than 2,000 teeth altogether in both upper and lower jaws.

The fore limbs are reduced to about one-sixth the size of the hind limbs, and from the size and shape of the foot bones, could not have borne much weight. They were probably used in supporting the fore part of the body when the creature was feeding, also aiding it to recover an upright position. The specimen represented as feeding is thus posed, so that the fore limbs carry very little of the weight of the body. There are four toes in the fore foot, but the thumb is greatly reduced. The hind legs are massive, with three well-developed toes ending in broad hoofs.

The long, deep, compressed tail was especially adapted for locomotion in the water. It probably served also as a balance when the creature stood erect on shore. The broad expanded lip of bone, known as the fourth trochanter, on the inner posterior face of the femur or thigh bone was for the attachment of tail muscles, similar to those that enable the crocodile to move its tail from side to side with such dexterity. In dinosaurs with short tails that are known by their construction to have been land forms, such as *Stegosaurus* and *Triceratops*, this trochanter is absent. The tail muscles were attached to the vertebræ by numerous rodlike tendons, which are preserved in position as fossils on the erect skeleton. This family of dinosaurs is thought to have been expert swimmers. Unlike other dinosaurs, their remains are frequently found in rocks that were formed under sea water, probably bordering the shores but nevertheless containing typical sea shells.

Among living reptiles, the small South American iguana (*Amblyrhynchus*) is thought to be comparable in its feeding habits and movements. These modern saurians live in great numbers on the shores of the Galapagos Islands off the coast of Ecuador. They feed exclusively on marine productions and swim out to sea in shoals, feeding on seaweed that grows at the bottom some distance from shore. The animal swims with perfect ease and quickness by a serpentine movement of its body and flattened tail, the legs during

this time being motionless, close pressed to its side. This is also the method of propulsion of the crocodile when swimming.

The carnivorous dinosaurs that lived on land, such as *Allosaurus* and *Tyrannosaurus*, were protected by their sharp biting teeth, while the land-inhabiting herbivorous forms were provided with defensive horns as in *Triceratops*, sharp spines as in *Stegosaurus*, or completely armored body as in *Ankylosaurus*.

Trachodont was sufficiently protected from carnivorous land forms by the power to seek and remain in the water, and was not provided with horns, spines, or plated armor. Its skin was covered with small raised scales, pentagonal in form on the body and tail where they were largest, with smaller reticulations over the joints, but never overlapping as in snakes or fishes. One of these skeletons was recently found with an impression of the skin surrounding the tail bones, thus giving even the contour of the tail. Preserved in the rocks with these dinosaur bones are impressions of a variety of leaves, fruits, and tree trunks. The living representatives of these trees are for the most part now found in the sub-tropics or warm temperate zones, showing that the climate of that period was very humid and warm.

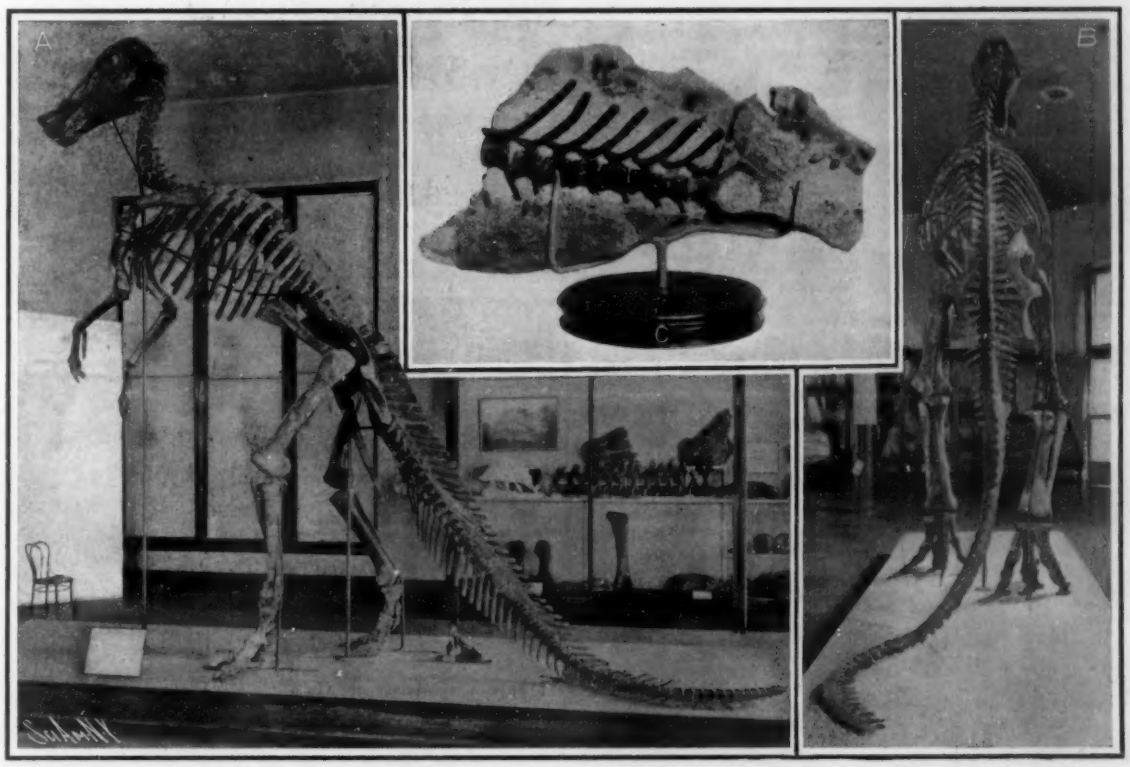
During the lifetime of the Trachodonts several species of palms grew in the present States of Montana and Wyoming; one closely resembles the living cabbage tree or palmetto of Florida. Fig leaves and fruits were abundant, and banana and persimmon leaves are common in these rocks. Here occur also such present widely separated trees as the *Ginkgo* now native of China, and the *Sequoia* or big tree of California. Horse-tail rushes were abundant and luxuriant in those early marshes; one specimen of *Equisetum* was found more than sixteen feet long and still incomplete at each end.

An elevation of the continent caused a drainage of the marshy lowlands, and a change from the tropical climate to one of lower temperature, with a consequent change in the vegetation. This probably was the chief factor in the extinction of the dinosaurs at the close of the Cretaceous period.

In the rivers and bayous of that remote period there lived also a great variety of *Unios* or clams and other fresh-water shells, interesting because they are the precursors of the modern Mississippi invertebrates. Impressions of the more common plants found in the rocks of that period, with sections of tree trunks and casts of these shells, have been introduced in the groundwork, thus completing a realistic and comprehensive picture of that remote period.

By courtesy of Charles H. Beck.

Iguanas (Amblyrhynchus) on the Galapagos Islands. These Resemble Trachodonts in Feeding Habits and Movements.



A. Trachodont Mounted to Show Its Extreme Height (17 Feet) When Standing Erect. B. Rear View of the Trachodont. C. Section of the Tail, Showing Impression of Skin.

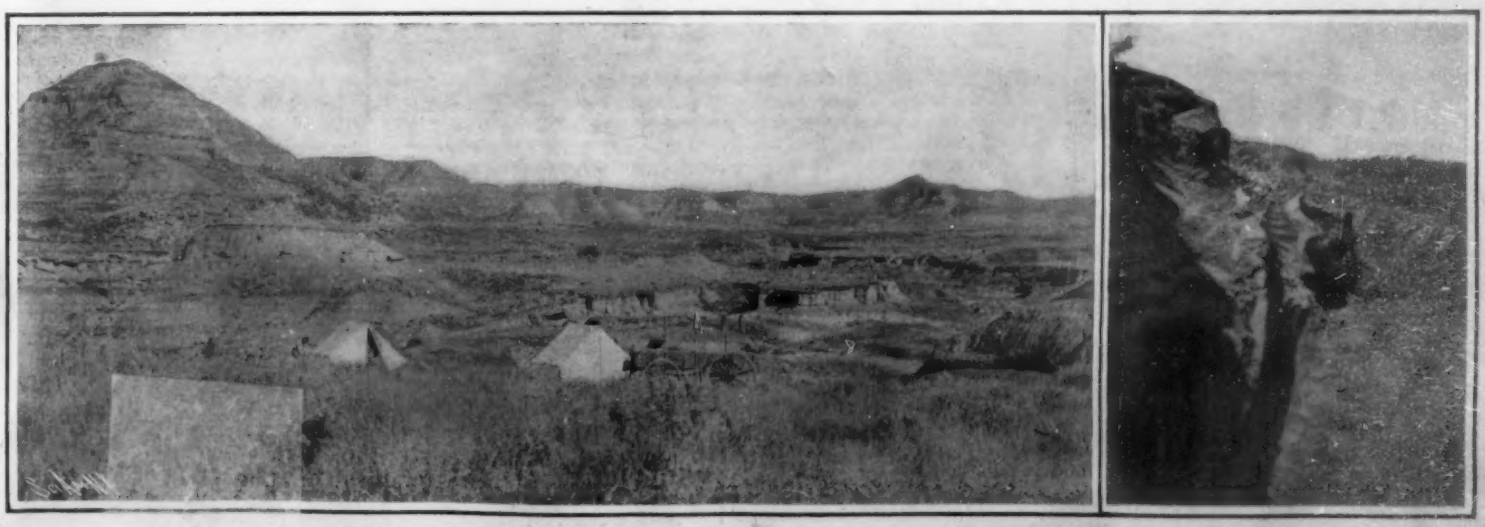
Deposits of Meerschaum in New Mexico.

Deposits of meerschaum have been located in New Mexico, according to a report made to the Geological Survey by Douglas B. Sterrett, one of its special agents. These deposits are in the upper Gila River Valley, one about twenty-five miles northeast of Silver City and the other at a mine about twelve miles northwest of Silver City. Mr. Sterrett recently visited the deposits and secured samples which when tested contained iron and particles of grit. Although inferior to the meerschaum of Asia Minor, the more compact massive material may perhaps be found free from iron stains and of better quality at a greater depth.

The Dorsey mine, lying twelve miles northwest of Silver City, is in the bottom and walls of the cañon of Bear Creek. This cañon has steep cliffs about 100 feet high at the base and other cliffs above rising to a height of several hundred feet. The rock forming the cañon walls is chiefly light and dark gray to brownish gray limestone, with some sandstone strata included. The meerschaum occurs in veins, lenses, seams, and balls in the limestone. All but the balls are fillings of fractures and joints which do not seem to be confined to any definite direction. The veins are filled with chert, quartz, calcite, clay, and meerschaum.

The principal source of meerschaum supply has been for many years the deposits in the plains of Eskishehr in Anatolia, Asia Minor, about 120 miles southeast of Constantinople. Deposits of the mineral are also reported to occur in Greece, on the island of Eubœa; in Moravia, Austria, near Hrubschitz; in Spain, near Vallecas, Madrid, and Toledo, and in Morocco.

On the French Northern Railway many carriages are lighted by acetylene, and the results of using this method of illumination are said to be satisfactory.



Camp on Crooked Creek, Montana, Showing Excavation From Which Trachodont Skeleton Was Taken.

Trachodont Skeleton Found Near Crooked Creek.

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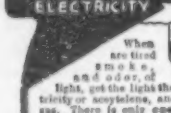

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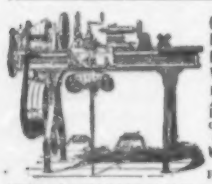

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RECENTLY PATENTED INVENTIONS.

Machines and Mechanical Devices.

SHIFTING ECCENTRIC.—H. LENTZ, 123 Kurfürstendamm, Halensee, near Berlin, Germany. A means is provided for effecting the displacement of machine parts by the direct contact of members appropriately toothed or screw threaded. When two racks with teeth arranged obliquely to length are in engagement, the movement of translation imparted to one of them may be directly transformed into a movement of translation of the other. The inventor applies this method for producing a displacement of parts such as the sheafs of distributing eccentrics, the frames of machine tools, etc.

ADDING ATTACHMENT FOR TYPE-WRITERS.—H. H. BURTON, Los Angeles, Cal. The attachment when secured to a typewriter interferes in no way with the normal operation of the machine. It may be readily removed or disconnected when not in use and when in use may be adjusted to any portion of the machine, whereby a column of figures may be added irrespective of their relative location as regards the width of the paper upon which the figures are being printed.

ROCK-CLEAVING MACHINE.—J. PIERSON, Pigeon Cove, Mass. The object of the inventor is to provide a novel, simple machine, which by manual control will accurately and rapidly cleave a granite slab into paving blocks, by transversely scoring the slab at equal distances apart, and thus cheapen the product as well as reduce manual labor that is usually employed for the purpose specified.

Prime Movers and Their Accessories.

ROTARY ENGINE.—R. LUNDQUIST, Laguna de Terminos, Campeche, Mexico. The invention relates to improvements in rotary engines adapted to be operated by steam, compressed air, or any other suitable motive fluid under pressure, and the object of the invention is to provide certain improved mechanism whereby the engine may be more readily controlled and rotated in either direction at will.

ROTARY ENGINE.—J. F. MASSEY, Douglas, Ariz. Ter. The engine forming the subject of this invention employs a casing in which a series of movable abutments are mounted with novel means for moving the abutments, and within the casing a steam wheel is revolubly having a channel for receiving the abutments, the wheel being provided with slides against which the steam acts, and pistons for moving the slides.

Pertaining to Vehicles.

WATER-BICYCLE.—J. L. HENRY, Watsonville, Cal. In this instance the object is to provide novel details of construction for a bicycle, which adapt it for easy and rapid propulsion upon and over the surface of a body of water, and also enable the device to be guided in any desired direction.

Designs.

DESIGN FOR A CAMPAIGN-BUTTON.—C. F. PEARSON, Portland Ore. The ornamental design shows a circular button with a distinct and attractive monogram 3.T.C., standing for "Third Term Club," and completely filling the area of the circle, and the figure and letters represented by a different color or texture against the background of the button.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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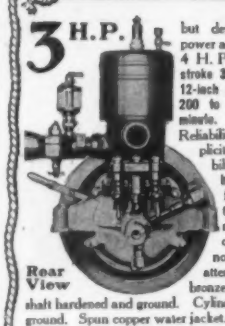

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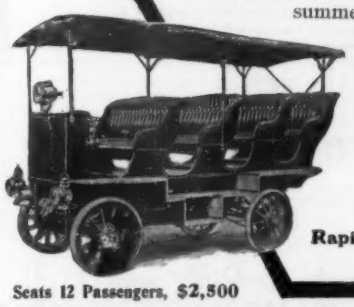

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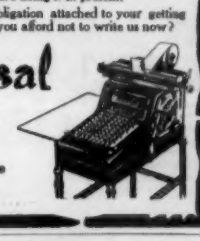

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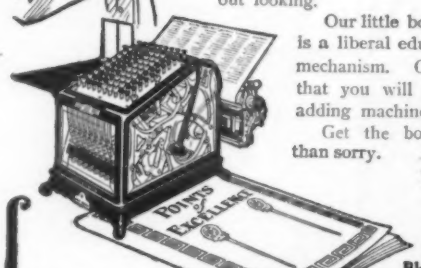

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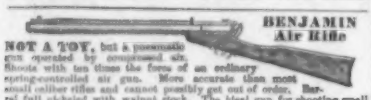

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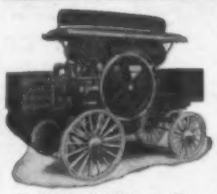

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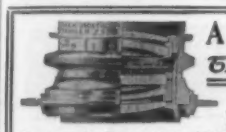

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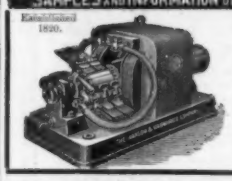

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